University of Alberta

Comparative Frameworks of Criteria and Indicators and Forest Certification in Canada and the United States

by

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Abstract

Criteria and Indicators (C&I) along with forest certification are instruments for contributing to sustainable forest management (SFM). This thesis examines these instruments in two case studies. The first case study assesses the application of C&I in Model Forests and forest companies in Canada. Its results suggest coherence in applying C&I within Model Forests and forest companies, hierarchical positions in using criteria and SFM elements within Model Forests and forest companies, and prevalence of a given criterion and SFM element between Model Forests and forest companies. The second case study compares the practice of Forest Stewardship Council (FSC) forest certification system in forest organizations located in Canada and the US. Its findings suggest that forest organizations differ in the importance they place on required FSC principles for forest certification; and the principles of 'indigenous people's rights' and 'forest benefits' are more likely to be present in Canada than in the US.

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Chapter 1: Introduction

1.1. Sustainable Development, Sustainable Forest Management and the Rise of Criteria and Indicators and Forest Certification

Forests are fundamental to society's well-being for both the provision of ecological services and the prosperity of national economies. However, forests not only provide multiple goods, services and benefits; they are also sources of conflicts. Inappropriate management of natural resources may promote forest degradation and habitat deterioration. As a result, problems such as loss of ecosystems, desertification, decrease in economic activities, and increases in poverty may occur. In the last twenty years the international debate on forests has been focused on the increasing rate of these problems (FAO, 2003a).

The origin of the concept of Sustainable Development can be traced to the debates held at the United Nations Conference on the Human Environment, held in Stockholm in 1972. In this international forum, not only were discussions about the environment and development initiated, but the forum also marked the beginning of a political commitment toward a new development model (Tolba, 1988). Global interest in balanced growth guided the report 'Our Common Future,' which defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987, p43). Both the United Nations Conference on the Human Environment and the Brundtland Report are considered to be elements that set the scene for the United Nations Conference on the Environment and Development (UNCED) that was held in Rio de Janeiro in 1992. This conference was also known as the Earth Summit (Tolba, 1992).

It is not clear when the concept of sustainable forest management (SFM) appeared for the first time. Nevertheless, it was after the Earth Summit that this concept began to be used frequently by different stakeholders (Patosaari, 2003). SFM has become a paradigm of forest management, an element in the decision-making process, a target to reach by different forest organizations, and forestry's contribution to sustainable development (Higmann *et al.*, 1999). There are a wide variety of initiatives related to SFM, ranging from international to local levels, private to public sectors, and legally to non-legally binding tools (FAO, 2003a).

Since the Earth Summit, and for advancing in SFM, developments of forest policy instruments and new forest market-based tools have been launched at both international and national levels. C&I (criteria and indicators) for SFM is widely accepted as a forest policy instrument, and forest certification is widely recognized as a market-based tool. Currently, both initiatives are considered the main tools for promoting SFM (Rametsteiner and Simula, 2003).

1.2 The Rise of Criteria and Indicators (C&I)

The International Tropical Timber Organization (ITTO) was a pioneer in developing the concept of C&I in the international arena and supported further discussion among countries. The ITTO started working on 'Criteria for the Measurement of Sustainable Tropical Forest Management,' a process which was concluded in 1992. This initial work proposed five criteria and twenty-seven 'preliminary indicators,' mainly related to the legal, institutional, and political aspects required for advancing SFM at the national level. This work also recognized the needs for technical indicators at the forest management unit level (Wijewardana, Caswell, and Palmberg-Lerche, 1997).

The Earth Summit highlighted the role of forests in achieving sustainable development. By adopting the Statement of Forest Principles, together with Chapter 11 of Agenda 21, countries clearly endorsed the notion of SFM and the use of C&I (United Nations Forum on Forests, 2004). Even though C&I was not well developed at this summit, countries started to accept the importance of C&I and promote international meetings and workshops for clarifying the economic, technical, social, ecological, scientific, and political aspects of this new concept.

C&I for SFM is an international, inter-governmental, public, and non-legally binding initiative developed primarily by governments with the support of international agencies such as the United Nations (UN) and the Food and Agriculture Organization (FAO) (FAO, 2001; Intergovernmental Panel Forests, 1997). Currently, C&I is also supported by some non-governmental organizations as well as some members of the private sector. C&I is defined as a tool for assisting in recognizing trends in the forest sector, for understanding the consequences of forest management practices, and for facilitating decision-making in forest policy (FAO, 2003b). In addition, C&I are also used for improving forest management interventions and for developing sustainable and productive forest estates (Wijewardana, 2004). To this end, criteria describe the principal components of SFM, including ecological, social, and economic aspects, while indicators define the instruments for assessing an aspect of the criterion, and which can be either quantitative or qualitative (Hendricks, 2003).

Some of the C&I applications include promoting a common understanding of SFM within and among countries, monitoring and assessing forest conditions and practices, influencing national forest policies, emphasizing sustainability as a dynamic concept, and reflecting new knowledge, scientific information, and society's values (FAO, 2003b; Prado, 2003; United Nations Forum on Forests, 2004).

Currently, more than 150 countries are involved in nine C&I processes. These processes were established considering similarities in geographical relations and forest ecosystems (FAO, 2001). A list of C&I processes and countries participating in these ongoing international initiatives is presented in Table 1-1.

Table 1- 1 Intergovernmental C&I Processes
(Adapted from FAO, 2001)

Process	Year of Beginning	Countries	Level
ITTO	1992	57	National, Forest Management Unit
Pan-European	1993	41	Regional, National
African Timber Organization	1993	13	Regional, National
Montreal	1995	12	National
Tarapoto	1995	8	Global, National, Forest Management Unit
Dry Zone Africa	1995	30	National
Near East	1996	30	Regional, National
Lepaterique	1997	7	Regional, National
Dry Forest Asia	1999	9	National

1.3 The Rise of Forest Certification

The beginnings of the forest certification process may be traced back to the 1990's before the UNCED, resulting from society's concerns about forest practices, deforestation, and loss of biological diversity, especially in the tropics (Upton and Bass, 1995). Initially, forest certification was a cause supported mainly by social and environmental non-government organizations, but now it has evolved as a market tool for improving SFM. According to De Camino and Alfaros (2000), forest certification is the only market-based incentive tool developed by the private sector.

Forest certification is an international, private, and non-legally binding initiative developed primarily by non-governmental-organizations, indigenous and ecological movements, and promoted by some private stakeholders and governments (Maser, 2001;

Vogt, Larson, Gordon, Vogt and Fanzeres 2000). Forest certification is considered as a tool for distinguishing between forest products that are a result of SFM and products produced by companies that practice non-sustainable forest management (Anderson and Hansen, 2003; de Camino and Alforos, 2000; Upton and Bass, 1995). As a result of forest certification, wood products may have better access to markets, social conflicts may be reduced, and a premium price may be obtained (Cantrell, 1998; Conroy, 2001; Fernholz and Guillery, 2000; Nebel, Quevedo, Bredahl, and Helles, 2005).

Forest certification systems have been described as market instruments for informing and educating consumers about wood products and forest management, as market incentives for improving SFM, a tool for retaining and gaining entry of products into the market place, and as procedures for evaluating the effect of forest management using standards previously agreed to on sustainable forest practices (Cabarle, et al, 1995; Upton and Bass, 1995; Vertinsky and Zhou, 1999).

Currently, there are four major forest certification programs: the Forest Stewardship Council[1] (FSC), the Pan-European Forest Certification (PEFC), the Sustainable Forestry Initiative (SFI), and the Canadian Standards Association Sustainable Forest Management Standard (CSA-SFM). In Canada and the USA, there are only three forest certification schemes: the FSC, the SFI and the CSA-SFM.

1.4 Nature and Scope of the Thesis Problem

Despite the fact that forest certification and criteria and indicators are widely accepted and used tools for achieving SFM, there seem to be many uncertainties as to how these tools are applied, and their contribution to SFM in Canada and the USA.

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[1] **Only FSC certification is present throughout all five continents.**

1.4.1 The Case of Criteria and Indicators

C&I are used to attempt to provide a framework for describing, monitoring and assessing advances towards SFM at national, sub-national and/or local levels. These initiatives may derive their legitimacy from being responding to public demands for SFM. They may focus on public policies to promote sustainability. In this sense, C&I may be seen as a form of state environmental governance that may affect regulations, norms and institutions.

Even though C&I for SFM was set-up as government initiatives, they have evolved as tools that are being used in the private sector as well. Different stakeholders may be interested in using these tools because the presence of C&I may allow for analyzing information on the contribution of forest management to social, economic and ecological aspects, and for improving forest management over time.

In Canada, model forests and forest companies are generally implementing C&I for SFM. These forest organizations are applying C&I for improving their forest management, and for evaluating their progress towards SFM. However, it is not clear how these forest organizations are using this instrument to advance towards SFM in Canada.

Some of the main questions that arise are: Who is using C&I in Canada?; What C&I frameworks are used and at what scale?; What the improvements have C&I made on economic, social and ecological aspects?; How have C&I been accepted among different stakeholders? How have C&I been applied at the local level?; How different are the C&I among different forest organizations?; How are model forests and forest companies using C&I information to improve their performance on sustainability?; How different is the application of C&I between Model Forests and forest companies?; Are these organizations addressing the same sustainability criteria?; What criteria and elements for SFM are being emphasized?; While many of these questions lie beyond the scope of this thesis, the focus here will be on how C&I are currently being used by model forests and forest companies in Canada.

1.4.2 The Case of Forest Certification

Forest certification programs attempt to determine and implement standards for SFM. Forest certification schemes may derive their legitimacy by responding to social demands for SFM. Thus, forest certification is focused on market demand, not public policies to promote sustainability. In this sense, forest certification may be seen as a form of non-state environmental governance, attempting to influence market practices.

World-wide, forest organizations may be interested in using this tool for capturing price premiums and/or market share, and for accessing new markets, making certification a market driven force. However, it is not clear how these forest organizations are applying this tool. More than a decade after the appearance of forest certification, questions regarding its performance continue such as: What have been the accomplishments of forest certification on economic, social and ecological aspects?; Has it preserved different ranges of economic, social and ecological values?; What range and type of values are consumers demanding?; What are local communities demanding from forest certification?; How different is the application of forest certification among countries?; Do nations respond to different social values?. It seems that there are many more questions than answers.

The purpose of this research is not to address all these questions. Rather its focus will be on comparisons regarding forest certification between Canada and the USA.

1.4.3 Research Objectives

The overall objective of this study is to advance the literature on C&I and forest certification by analyzing how C&I is being implemented in Canada, and how forest certification is being practiced in Canada and the USA.

The objective of the C&I case study is:

- To assess whether differences in the application of C&I, and in the emphasis among criteria and elements exist within and between Model Forests and forest companies in Canada.

The objective of the forest certification case study is:

- To investigate whether the practice of Forest Stewardship Council (FSC) forest certification is different among forest organizations between Canada and the USA, and, if so, to assess what those differences are.

1.5 Thesis Organization

This thesis comprises four chapters subsequent to the first. In Chapter 2, a literature review of C&I and forest certification is presented. This literature review highlights the application and the development of C&I in Canada, and the application and current status of forest certification in Canada and the USA. In Chapter 3, the C&I case study is developed. Background on C&I is presented, along with a description of Model Forests and forest companies sampled in this study, the methodological approach taken to study C&I, and results. In Chapter 4, the forest certification case study is presented.

Information on forest certification, corporate social responsibility and forest values is introduced. In addition, research questions, methodology, and results for the comparison of forest certification between Canada and the USA are carried out. Chapter 5, concludes this research with a summary of these case studies, recommendations for future research, and conclusions.

Chapter 2: Background and Literature Review

2.1. The Development of Forest Sector Criteria and Indicators (C&I) in Canada.

Since the ratification of the Canadian National Forest Strategy (March 1992), and Canada's participation in UNCED (Earth Summit-June 1992), Canada has promoted, at both the national and international levels, a variety of initiatives related to SFM (Canadian Council of Forest Ministers, 1997). In 1992, the Canadian Council of Forest Ministers (CCFM) begun to act on the commitments made at Rio with respect to forests through the National Forest Strategy, and also to begin a process to develop C&I for sustainable forest management (SFM). This process included the involvement of scientists, provincial representatives, experts in socio-economic issues, and forest professionals.

In 1993, the Conference on Security and Cooperation in Europe convened an international seminar in Montreal on the issue of the 'Sustainable Development of Boreal and Temperate Forests.' The main purpose of this conference was to review the concept of SFM and to supply possible C&I at the country level. This conference led many countries to work towards C&I for boreal and temperate forests, and Canada assumed an important role in promoting this joint process among non-European countries. In June 1994, the 'Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests' was established. This initiative includes twelve countries, and is currently called the 'Montreal Process' (Montreal Process Working Group, 1997).

The 'Montreal Process' is an international agreement concerning C&I for the conservation and sustainable management of temperate and boreal forests. This process has been ratified by twelve countries on five continents, representing 90% of the world's temperate and boreal forests, 60% of all forests on the globe, 35% of the world's population, and 45% of world trade in wood and wood products (Montreal Process Working Group, 1999). The Montreal Process aims to provide not only a common understanding of what sustainable forest management is, but also a shared framework for describing, assessing, and evaluating a country's improvement in the direction of sustainability at national level (Montreal Process Working Group, 2004). For the countries that are members, the Montreal Process is considered an important international forest policy tool to achieve SFM.

The CCFM C&I and the Montreal Process were developed over the same period and are similar in many ways (Canadian Council of Forest Ministers, 1999). Both processes recognize that C&I have to be considered as a whole, and thus no single criteria or indicator may be used to assess SFM (Canadian Council of Forest Ministers, 1999).

Today, there is a clear difference in how Canada uses the C&I process at federal and provincial levels. The CCFM C&I framework is a national level framework that Canada uses to report on national progress toward SFM. Some provinces, however, have their own C&I frameworks that they use to show their provincial progress towards SFM. At the international level, most of the indicators in the CCFM Framework are compatible with and comparable to the 'Montreal Process' indicators, while at the same time providing more detail on values of importance to Canada. Information from the CCFM C&I reports forms the basis for Canada's contribution to the 'Montreal Process' reports.

C&I are not only used by federal and provincial governments, but also by the private forestry sector. Various forest companies across Canada are implementing C&I at the forest management unit level.

2.2 C&I and Economic Issues

C&I is a tool that not only attempts to provide a common understanding of SFM, but also supplies a framework for making decisions concerning SFM at different levels, including local interests and social values in forest planning, and assessing forest practices related to sustainability (Karjala, Sherry, and Dewhurst, 2004; Mendoza and Prabhu, 2000; Reynolds, Norman, and Gordond, 2003; Varma, Ferguson, and Wild, 2000).

Even though the importance and use of C&I is widely recognized, not much research has been done to evaluate them. A few researchers have begun to develop methods for assessing the use and relevance of this tool (Mendoza and Prabhu, 2003a; Mendoza and Prabhu, 2003b). While others have started research for evaluating differences between C&I at the national level and its implementation at the forest management unit level (McDonald and Lane, 2004).

A useful indicator for assessing sustainability needs to be measurable, able to forecast conditions, relevant, reliable, easy to understand, able to provide information for decision-making, cost effective, applicable, and appropriate to scale of use (Centro Internacional de Agricultura Tropical, 1996; Mittelsteadt, Adamowicz and Boxall, 2001). In addition, forest-related indicators need to include economic aspects such as goods and services that may or may not be in the market (Mittelsteadt *et al.*, 2001; Toman, Lile and King, 1998). Moreover, indicators of economic sustainability should be targeted toward an economic unit (i.e.: a community, region, or country) rather than a specific sector (i.e.; mining, forestry, or fishery) (Mittelsteadt *et al.*, 2001).

Despite issues associated with C&I, it is believed that this tool is an appropriate means to assess the path towards sustainable development (Bossel, 1999). Nevertheless, an appropriate set of economic indicators regarding sustainability is required to assess the overall welfare of the forestry sector, to join together economic and ecological aspects, and to evaluate forest's contributions to sustainability at an appropriate scale (Adamowicz, 2003).

2.3 Forest Certification Schemes in Canada and the USA

Three forest certification schemes are applied in Canada and the USA: the Canadian Standards Association Sustainable Forest Management Standard (CSA-SFM), the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI). In the following sections, a brief description of each scheme is presented.

2.3.1. The Canadian Standards Association Sustainable Forest Management Standard (CSA-SFM)

In 1994 the Canadian Sustainable Forestry Coalition requested that the Canadian Standards Association (CSA) develop a sustainable forest management standard for Canada. In 1996, these standards were completed and approved, and in 2000 they were reviewed (Canadian Sustainable Forestry Certification Coalition, 2004a). The CSA is in control of the Canadian Standards Association Sustainable Forest Management Standard (CSA-SFM), and an elected Board controls the CSA.

The CSA is open to both individuals and organizations. A technical committee, independent of the CSA, coordinates the development of standards. For the design of the forestry standards, a multi-professional committee with participants from government, the forest industry, environmental organizations, and academics was formed (Canadian Sustainable Forestry Certification Coalition, 2004a).

The CSA-SFM standard is based on six criteria. The framework used for the development of this standard was the CCFM C&I for SFM. These criteria are shown in Table 2-1.

Table 2- 1 SFM Criteria Used in the Canadian Standards Association Certification Scheme (Adapted from Canadian Standards Association, 1996)

Criterion	Description
Criterion 1: Conserving Biological Diversity	To sustain the functions and diversity of living organisms, it is necessary to conserve biological diversity.
Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity	To conserve forest conditions and productivity, it is necessary to maintain the health and vitality of ecosystems.
Criterion 3: Conservation of Soil and Water Resources	To protect forest ecosystems, it is essential to conserve soil and water resources.
Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles	To contribute to the health of global ecological cycles, forests at the local level must be well managed.
Criterion 5: Multiple Benefits to Society	To make available multiple goods and service, it is necessary to sustain flows of forest benefits for current and future generations.
Criterion 6: Accepting Society's Responsibility for Sustainable Development	Society must ensure that SFM decisions are adequate, reasonable, and effective.

The CSA-SFM has three different labels for forest products according to the percentage of certified wood in the product. The label used in this certification system is referred to as a CSA-SFM Mark (Canadian Sustainable Forestry Certification Coalition, 2004a). There are three labels in use based on the CSA-SFM Standard (known as the Z809 standard). The requirements for each label are presented in Table 2-2 (Canadian Sustainable Forestry Certification Coalition, 2004a):

Table 2- 2 Requirements for Forest Product Certification by the Canadian Standards Association (Adapted from Canadian Sustainable Forestry Certification Coalition, 2004b)

Labels	Requirements
100% Certified.	100% of the product has been tracked from its origin point (a Z809 certified forest) to the final consumer.
Input / Output System (% in / % out) for Solid Wood	The minimum average input is 70% (by volume or by weight) of certified (originating from a certified Z809forest) raw material. In addition, none of these raw materials should come from controversial sources.
Minimum Average Percentage System for Composite Products	Basically, it has the same requirements as the previous label [minimum of 70% (by volume or by weight) of certified Z809 forest], but it applies to composite products not solid products.

As of December, 2003, the total area of CSA certified forest was 28.4 million hectares (Canadian Sustainable Forestry Certification Coalition, 2004b), which are under the management of seven forest companies across Canada.

2.3.2 The Forest Stewardship Council (FSC)

The Forest Stewardship Council (FSC) is an independent, non-profit organization that was established in Oaxaca, Mexico. It was founded in 1993 by various stakeholders including non-governmental organizations, workers' unions, representatives of indigenous people, timber companies, and retail businesses (FSC, 2004a; Parkins, 2003). The objective of the FSC is to encourage environmentally reliable, socially responsible, and economically feasible management of the world's forests by constituting a worldwide regulation of principles of forest stewardship (FSC, 2004b).

The FSC is an international organization that can be found in sixty-six countries (FSC, 2004c). Membership is open to individuals and organizations that are concerned with indigenous, social, economic, and environmental aspects. Governments are not allowed to be members. An elected Board of Directors that represents environmental, economic and social aspects manages the FSC (FSC, 2004d).

Even though the FSC is international in scope, it assists in the establishment of national certification programs that are developed under its framework. In this way, the

FSC has promoted national programs in thirty-two countries (FSC, 2004c). According to Shiraishi (2001), the aspect that makes the FSC distinct from other certification schemes lies in its focus on local environmental and social aspects, and community participation.

The FSC's Principles and Criteria apply to all tropical, temperate, and boreal forests, whether they are natural or planted. The FSC principles required for obtaining forest certification in forest lands are listed in Table 2-3.

Table 2- 3 Forest Stewardship Council Principles
(Adapted from FSC, 2004b)

Principle	Description
Principle #1: Compliance with laws and FSC principles	Forest management must not only comply with national laws, international treaties and agreements that a country is signatory to, but also observe all FSC Principles and Criteria
Principle #2: Tenure and use rights and responsibilities	Use rights and long-term tenure of the land and forests must be stated clearly.
Principle #3: Indigenous peoples' rights	Indigenous people's rights (legal and traditional) to own, manage, and administer their lands and resources must be respected.
Principle #4: Community relations and workers' rights	Forest management must improve the social and economic well being of forest workers and local communities in the long-term.
Principle #5: Benefits from the forest	Planning forest management must include an adequate use of the forest's multiple goods and services to guarantee not only economic feasibility, but also a broad variety of environmental and social values.
Principle #6: Environmental impact	Forest management must assess its impacts to conserve biological diversity, water resources, soils, fragile ecosystems, and landscapes.
Principle #7: Management plan	An up-to-date management plan pertinent to the level and size of the operations must exist.
Principle #8: Monitoring and assessment	To control possible negative side effects of forest management, it is necessary to monitor yields of forest products, chain of custody (CoC), management activities, and their social and environmental influence.
Principle #9: Maintenance of high conservation value forests	As a part of an integral forest management plan, it is fundamental to preserve high conservation value forests and use a precautionary approach.
Principle # 10: Plantations	The establishment of forest plantations must be designed in agreement with all previous principles and criteria. Forest plantations may supply social and economic benefits, and they should supplement the management of natural forests.

Organizations seeking FSC certifications must undergo independent third-party certification that is provided by a certifier recognized by the FSC (FSC, 2004a). The FSC has a single label that is applied to products that come from certified forests and are accredited by a certification body. The labelled products have to meet the requirements presented in Table 2-4.

Table 2- 4 Types of Labels Used by the Forest Stewardship Council (Adapted from Forest Certification Resource Centre, 2004a)

Product	Requirements
Raw material	100 percent of raw material must come from certified forests
Solid wood products	A minimum of 70 % by volume of the timber used in fabrication of the products must come from certified forests
Chip and fibre products	A minimum 17.5% of the total fiber of the product by weight and 30% of total virgin fiber by weight must come from certified forests

The total area of FSC-certified forestland globally stands at 39,87 million hectares, including approximately 3,310 chain of custody, and 560 certified logo users (FSC, 2004e; FSC, 2004f). The area being certified is increasing quickly, up 27% between 2002 and 2003 (FSC, 2004e). The most significant changes in area were:

- A high rate of growth in the United States, increasing the total area of U.S. FSC-certified forest by 0.25 million hectares to 3.71 million hectares.
- A high rate of growth in Canada, increasing Canada's total FSC-certified area from less than 1 million hectares to over 4.2 million hectares.
- New certified areas in Croatia, Poland, and Sweden of over 2 million hectares.

In general, the FSC is most prevalent in native forests (43% of total certified FSC forests), on public lands (64% of total certified FSC forests), and in developed countries (85% of total certified FSC forests). In developed countries, a high percentage of certified forest is public land, while in developing countries, a high portion of certified forest is private land (FSC, 2004e).

2.3.3 Sustainable Forestry Initiative (SFI)

In 1994, the American Forest & Paper Association initiated a plan to improve forest practices of their members. This process ended with the beginning of the SFI's Principles and Implementation Guidelines (American Forest and Paper Association, 2004a). In 1998, the SFI's original Principles and Implementation Guidelines were adjusted to produce an industry standard. In the same year, the SFI promoted voluntary verification options that permitted first, second, and third-party certifications for its members and participants.

The SFI program is a certification scheme with a broad system of principles, objectives, and indicators developed by professionals from different areas (American Forest and Paper Association, 2004b). The SFI promotes the growing and harvesting of trees with the goals of conservation of wildlife and the protection of soil and water, among other responsibilities (American Forest and Paper Association, 2004b).

The American Forest & Paper Association administers the SFI system, communicates results, and writes reports, among other duties. In 2000, the Sustainable Forestry Board was created. This board assesses procedures in order to manage dispute resolution and to control program quality. In 2001, the Sustainable Forestry Board became a non-profit, independent organization, with the goal of guaranteeing the technical and scientific reliability of the program. Its members belong to conservation organizations, the forestry industry, and natural resource fields (Sustainable Forestry Board, 2002).

To participate in the SFI program, participants are required to adopt principles and objectives in their forest management planning. The SFI principles for sustainable forestry are presented in the Table 2-5.

Table 2- 5 Principle Underlying Sustainable Forestry Initiative Certification Scheme (Adapted from American Forest and Paper Association, 2004b)

Principle	Description
Principle 1: Sustainable Forestry	Sustainable forestry can be achieved by carrying out a land stewardship ethic that incorporates forest management with preservation of forest ecosystems. It is possible to meet the needs of the present without compromising the ability of future generations to meet their own needs.
Principle 2: Responsible Practices	Achieving responsible practices may improve sustainable forestry in economic, environmental and social aspects.
Principle 3: Forest Health and Productivity	To maintain forest health and productivity, it is important to secure forests from wildfire, pests, diseases, and other damaging agents.
Principle 4: Protecting Special Sites	Sustainable forestry requires managing and conserving sites of special significance (e.g., biologically, geologically, culturally or historically significant).
Principle 5: Legal Compliance	Sustainable forestry requires observing all related federal, state, or local forestry and environmental laws and regulations.
Principle 6: Continual Improvement	Sustainable forestry requires monitoring and enhancing forest management practices, and to continuing improving forestry practices.

The SFI accreditation program requires following the requisites of the American National Standards Institute and Registrar Accreditation Board. The SFI has four different product labels depending on the types of forest operations. One label, the Certified Participant under the category Primary Producers, is designed for mills that obtain most of their raw material straight from the forest. The other three labels are under the category Secondary Producers and are designed for mills that run mainly processed wood: a) Participating Manufacturer, b) Participating Publisher and c) Participating Retailer. The labels have the requirements shown in Table 2-6.

Table 2- 6 Types of Labels Used in SFI
(Adapted from American Forest and Paper Association, 2004c)

Category	Label	Requirements
Primary Producer	Certified participant	▪ Primary producers must be SFI Program Participants that are independently third party certified to the SFI Standard. ▪ Primary sources must be certified either by SFI Standard or the American Tree Farm System® and/or be procured through a third party certified procurement system. ▪ Certified material may include recovered wood fibre, and may be from a credible supplier outside the U.S.
Secondary Producer	Participating manufacturer	▪ A minimum of two-thirds (by weight) of the wood or fibre should come from suppliers that are certified either the SFI or the American Tree Farm System. ▪ Certified material from a credible supplier outside the USA must come from either forest plantations or well-managed forests in correspondence with laws and accepted sustainable forest operations. ▪ Must supply independent, third party certification proving that qualify to use the SFI label.
	Participating publisher	
	Participating retailer	

As of February, 2004, 41,8 million hectares of forests were SFI certified in Canada and the USA, and of this, 39,01 million hectares were third-party certified (American Forest and Paper Association, 2004d). For this forest certification system, there is no information on chain of custody, logo users, and rate of growth.

2.4 Trends in Forest Certification for Wood Markets

Currently there are approximately 124 million hectares globally that are certified under some forest certification scheme, which is 3.2% of the total world's forest area[2] (Ramesteiner and Simula, 2003). Close to 55% of all total certified forest area is in Europe, 40% is found in North America, and the less-developed countries' share is about 4%. Certified products are mainly from temperate forests (Ramesteiner and Simula, 2003).

According to the United Nations Economic Commission for Europe (UNECE) and the Food and Agriculture Organization (FAO) (2003), certified forest areas under some certification scheme are estimated to supply about 300 million m³ on an annual basis. This is 7.5% of the world's apparent wood consumption in 2002 (wood fuel, round wood, sawn wood, and wood-based panels comprising 4000 million m^3).

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[2] This number may be an overestimation because of overlaps among certification schemes.

Business to business[3] markets for certified forest products are mainly in Germany, the United Kingdom, and the United States; consumer demand for certified forest products is still low in Europe and North America relative to the current overall demand for wood products (Hansen, Forsyth and Juslin, 2000; UNECE-FAO, 2003).

Do-it-yourself retailers have been demanding certified forest products and encouraging their suppliers to certify (Lober and Eisen, 1995). However, in the areas of construction, pulp, and paper, the supply chain has not been so effective (Bass et al, 2001). Nevertheless, Vidal, Kozak, and Cohen (2003) predict that in North America, nearly 50% of solid wood producers in Canada and the USA will be certified by 2007.

2.5 Forest Certification and Economic Issues

Forest certification was designed as a means to inform consumers about forest management and business practices. Even though forest certification can be considered as an initial step to promote sustainability, it is highly unlikely that it will be a solution to deforestation and forest degradation because market institutions are not always an adequate way to induce SFM (Kiker and Putz, 1997).

In Europe, studies have shown that consumers may be willing to pay a premium price in the range of 5-15% for certified wood products (Cabarle *et al.*, 1995; Lober and Eisen, 1995; Mattoo and Singh, 1994). In the USA, research has shown that clients may be willing to pay a premiums price in the range of 4.4-18.7%, but 37% of consumers were not willing to pay an extra value for wood-certified products (Ozanne and Vlosky, 1997). In 2000, the same researchers replicated this study with the same population and found that the understanding of the forest certification concept had increased, but purchases of certified-forest products had decreased because consumers do not perceive efficacy in this tool (Ozanne and Vlosky, 2003). Even though public awareness of forest certification is increasing, research on consumer behaviour indicates that marketing strategies will need to be modified because consumers are receiving inadequate information about the significance of certification schemes and labels (FAO, 2003b).

The limited consumer's response to purchase certified forest products may suggest that either consumers are not interested in environmental issues, or consumers are not willing to pay more for certified products. A possible explanation for this phenomenon is that actual forest certification labelling may not be sufficient to inform consumers about environmental attributes of wood certified products, and therefore, it may be necessary to modify the current labelling system for timber certified products (Teisl, 2003). In fact, market studies have suggested that appropriate label design may positively modify consumer and producer behaviour towards products with environmental attributes (Bjørner, Gårn and Russell, 2004; Teisl, Roe, and Hicks 2002).

From the producer's perspective, forest certification may be feasible and companies may be induced to certify if the market provides a price premium for certified timber if certification is necessary to maintain market share. Nevertheless, there are two main reasons cited as impediment to of forest certification: the cost involved in forest management, and the lack of commercial advantages (Cerda and Lira, 2002; Sedjo, 1997; Varangis, Crossley and Primo, 1995).

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[3] Business to business is defined as a Business that sells products or provides services to other businesses (Internet Marketing Reference, 2004)

Despite these considerations, some forest companies are supporting this tool. Reasons to support this tool may include that forest products are highly dependent on foreign markets and these markets are demanding sustainable produced wood. Moreover, companies may need to ensure market niches, or they may want to show their concern for environmental and social aspects (Cashore, Auld and Newson, 2003; Cashore *et al*, 2003; Forest Enterprises Ltd, 2004; van Kooten, Nelson and Vertinsky, 2004; Vertinsky and Zhou, 1997).

2.6. A Comparison of Criteria and Indicators and Forest Certification

In general, C&I and forest certification are tools for promoting and enhancing SFM. They are considered as non-legally binding instruments, and both are interconnected in the elements that define SFM in economic, social and environmental aspects. Both are widely used worldwide, and both instruments may be applied at the forest management unit level even though C&I is applied at the national forest level and/or sub-national forest level as well.

The origin of these initiatives is different: C&I was developed mainly as an intergovernmental process driven by the respective forest service in each country, whereas forest certification was mainly developed by various stakeholders, excluding governments, driven by non-governmental organizations.

Each tool was designed for a different audience. C&I was designed mainly to be used for governments and policy-makers in the process of decision making and to be used by the general public as an information channel regarding SFM at the national level. Forest certification was designed mainly to be used by forest companies and stakeholders in the certification process and by consumers as a channel to receive information on environmental and social attributes of wood certified products. Today, both instruments reach the same audiences.

Participants using each tool are the same, but with a different emphasis. In C&I, agents are frequently public agencies with inputs from other stakeholders and academia, while forest certification agents are private sector firms and other stakeholders with a minimum participation from governments.

The approaches of both instruments are similar. Intergovernmental C&I indicators are mainly descriptive (quantitative or qualitative), showing trends and monitoring and assessing SFM at national level, while forest certification involves indicators that are evaluated or assessed at forest management unit level against standards or requirements of SFM previously accorded (Rametsteiner and Simula, 2003; Washburn and Block, 2001). However, C&I are also used by forest organizations at the forest level.

Among the nine ongoing international C&I processes, there are seven general criteria used: biological diversity, extent of forest resources, productive functions of forest resources, forest health and productivity, protective functions of forest resources, socio-economic functions, and legal, policy, and institutional frameworks (Instituto Nacional de Bosques *et al,* 2003).

These criteria are roughly equivalent to those used in the forest certification systems to assess forest management practices and inform consumers. C&I is used in forest certification. In fact, it is recognized that one of the many applications of C&I is assisting as a framework for forest certification. However, C&I is not a certification system itself (Instituto Nacional de Bosques *et al,* 2003).

Even though Intergovernmental C&I are not performance standards, there is a conceptual link with forest certification. Both C&I and forest certification provide standards to assess and track SFM based on economic, social and environmental criteria. For example, the Pan European Operational Level Guidelines, which are the basis to certify under this scheme, are based on the six criteria of the Pan-European Criteria for Sustainable Forest Management. In the case of the inter-governmental Montreal Process, it is recognized that these criteria may establish the basis for the development of national certification standards, and in the case of Canada, this was the framework used to develop the Canadian forest certification standard. According to the Pan-European Forest Certification (PEFC), endorsement and mutual recognition can be applied to standards developed in every country if countries use its respective C&I process as a reference base (Pan European Forest Certification Program, 2004).

In summary, C&I and forest certification are connected at different levels, and policy actions in one instrument may affect the performance and development of the other tool.

Chapter 3: Case Study on Criteria and Indicators of Sustainable Forest Management

3.1 Introduction

This chapter begins with background information about criteria and indicators (C&I) for Sustainable Forest Management (SFM) in Canada. The literature on the conceptual development of indicators and the Canadian Council of Forest Ministers' (CCFM) Criteria and Indicators (C&I) framework are also examined. Moreover, this chapter describes model forests and forest companies in Canada.

The following sections discuss the methods, research design, and results. A content analysis was used to assess whether or not the indicators used by model forests and forest companies in Canada observe the CCFM C&I framework and literature on C&I of SFM. The research design explains techniques for gathering and analyzing data, and outlines formats for presenting research findings. Results are presented in three levels: *consistency*, *rankings of elements and criteria*, and *dominance*, with comparisons of how model forests and forest companies apply the indicators and an explanation of the prevalence of some criteria and elements. A discussion of the results concludes the chapter.

3.2. Background of Criteria and Indicators for SFM

No specific theories are available to guide the construction of indicators for SFM in Canada. In this research, two main C&I frameworks are presented: literature relevant to the indicators of sustainability, and the Canadian Council of Forest Ministers (CCFM) C&I. These frameworks may influence the development of indicators employed by the model forests and forest companies.

3.2.1 Literature on Indicators and Sustainability

Today, the indicators of sustainability are widely accepted and recognized to be fundamental elements for improving the political and technical processes leading towards sustainable development (Centro Internacional de Agricultura Tropical, 1996). Indicators of sustainability may be considered as monitoring tools to assess trends, and as a mechanism for communicating science-based information to stakeholders (Linddal, 2000). In addition, Adamowicz (2003) recognized that the indicators are important elements in the management and planning of natural resources. Moreover, indicators of sustainability are used more extensively and intensively, and are applied at different levels in the forestry sector, though their design may not always respond to technical or scientific recommendations.

No general consensus exists about the scientific and conceptual components that should be included in a sustainability indicator (Hart, 2004a); however, the indicators have certain concepts in common that are relevant for sustainability.

Different researchers have recognized these common aspects. For example, sustainability should include aspects of inter-generational and intra-generational equity (Hart 2004a; Stavins, Wagner and Wagner, 2002). Additionally, sustainability requires a long-term view of the sector in question as well as the links among economic, social, and environmental aspects of that sector (Bowler, Bryan and Cocklin, 2002; Hart, 2004b; Linddal, 2000; Vosti and Thomas, 1997). In the same way, an SFM indicator should coincide with an appropriate economic unit (e.g., forest management unit, or the community, provincial, or national level) to assess its impact (Linddal, 2000; Centro Internacional de Agricultura Tropical, 1996). Similarly, a socio-economic indicator should reflect economic theory (i.e., concepts of well-being or economic welfare), to understand what is relevant to the sustainable development process (Adamowicz, 2003; Mittelsteadt *et al.*, 2001). Finally, indicators related to forests should include other values beyond marketed goods and services (Centro Internacional de Agricultura Tropical, 1996; Segnestam, Winograd and Farrow, 2000). Indeed, addressing and accounting for ecosystem goods and services such as wildlife habitat, recreation, and landscape are important aspects for forest sustainability (Adamowicz, 2003). Criteria and elements of sustainability indicators drawn from the literature review are presented in Table 3-1.

Table 3- 1 Criteria and Elements for Sustainability Indicators (from the Literature Review)

Criteria	Elements	Relevance
Equity	Intra generational - within a given generation	Equity is an important characteristic of sustainable development. Today, governments are concerned about how costs and benefits might affect inter and intra generational equity. Equity might be affected by decisions on resources use; thus, SFM should consider a balance in intra and inter-generational elements for contributing to improve economic, social and environmental outcomes.
	Inter generational - between present and future generations	
Sustainability	Economic	Sustainability promotes a balance among economic development, social equity and environmental values protection. These three aspects are essential to properly advance towards sustainability.
	Social	
	Environmental	
Level	Community	Two different levels of sustainability are considered here. The first level is the community level. At this level, forest companies and/or Model Forests should allocate their resources and plan their activities in order to promote community goals. The second level is the regional-provincial level. At this level, forest companies and/or Model Forests should allocate their resources and plan their activities in order to promote regional-provincial goals.
	Regional-Provincial	
Ecosystem goods and services	Address ecosystem goods and services	Ecosystem goods and services are benefits that humans obtain from natural ecosystems (Christensen et al. 1996). Examples of goods comprise forest products, non-timber forest products and recreation. Examples of ecosystem services consist of soil production, clean water, and pure air. The incorporation of these goods and services is essential to advance in sustainable forestry.

3.2.2 Canadian Council of Forest Ministers (CCFM) Criteria and Indicators (C&I)

In 1993, the CCFM created the Steering Committee on C&I for SFM in Canada. The committee was supported by a scientific panel and a technical council (Canadian Council Forest Ministers, 1995). The CCFM framework is an important reference point for SFM in Canada. Moreover, the C&I process was developed and enhanced through the participation of various stakeholders who identified values associated with SFM (Canadian Intergovernmental Conference Secretariat, 2003).

The CCFM established a set of 6 criteria, 22 elements and 82 indicators. The CCFM also recognized that no single criterion could assess sustainability, and that each indicator should be examined in the context of the whole set, in contributing towards sustainability in Canadian forests (Canadian Council Forest Ministers, 1995).

The CCFM recognizes SFM as a continuously improving process, and as such, the CCFM acknowledges that this process needs to be enhanced as new information is available, or as society's values evolve, or scientific research results are more accurate in describing forest sustainability. In 2001, based on this premise and the CCFM's implementation and reporting of the C&I, it reassessed the C&I framework. During this re-examination process, participants from different sectors (i.e. government, industry, and academia, among others) met several times to discuss, review, and refine the existing set of indicators. The group not only came out with a reduced number of elements and indicators, but also additional information was developed for this newer set (i.e. rational and measurement units) (Canadian Council Forest Ministers, 2003). Indeed, the process continues to evolve and undergo improvements.

In 2003, the CCFM released the new C&I version. The improved version was intended to identify fundamental components of SFM in Canada, and to apply indicators more effectively. In addition, the framework provided the basis for an ongoing domestic and international dialogue on SFM (Canadian Council Forest Ministers, 2003). A list of indicators in the revised CCFM C&I framework is presented in Appendix A. Since the indicators that were analyzed in this research were constructed before the new C&I version, the original framework was used for this investigation (Table 3-2).

Table 3- 2 Criteria and Elements in the Original CCFM C&I Framework (Adapted from Canadian Council Forest Ministers, 1995)

Criteria	Elements	Relevance
Criterion 1 Conservation of biological diversity	1.1. Includes ecosystem diversity 1.2. Includes species diversity 1.3. Includes genetic diversity	By maintaining a variety of ecosystems, species and genes, it is possible to ensure that forest ecosystem will adapt to changes and disturbances.
Criterion 2 Maintenance and enhancement of forest ecosystem condition and productivity	2.1. Includes incidence of disturbance and stress 2.2. Includes ecosystem resilience 2.3. Includes extent biomass	Forest productivity depends on ecological functions, processes, and on ecosystem capacity to recover from or adapt to disturbances.
Criterion 3 Conservation of soil and water resources	3.1. Includes physical environmental factors 3.2. Includes policy and protection forest factors	Soil and water are fundamental components of forest ecosystems; they sustain ecosystem functions, and biological diversity among others.
Criterion 4 Forest ecosystem contributions to global ecological cycles	4.1. Includes contributions to the global carbon budget 4.2. Includes forest land conversion 4.3. Includes forest sector carbon dioxide conservation 4.4. Includes forest sector policy factors 4.5. Includes contributions to hydrological cycles	Forest management may also influence global ecological cycles. Forests are essential to the global carbon cycle, and its appropriate forest management may assist to maintain global processes.
Criterion 5 Multiple benefits to society	5.1. Includes productive capacity 5.2. Includes competitiveness of resource industries 5.3. Includes contribution to the national economy 5.4. Includes non-timber values	Forest sustainability is also connected with economic and social processes. Forest sustainability should consider timber aspects as well as non-timber values such as water, recreation, and wildlife.
Criterion 6 Accepting society's responsibility for sustainable development	6.1. Includes aboriginal and treaty rights 6.2. Includes participation by aboriginal communities in SFM 6.3. Includes sustainability of forest communities 6.4. Includes fair and effective decision making 6.5. Includes informed decision making	Forest sustainability should consider social values. Sustainable forest management should include the cultural socio-economic needs of different communities.

3.3 Description of Forest Companies and Model Forests in Canada

In Canada, two main organizations use indicators for SFM: forest companies and Model Forests.

Forest companies in Canada are profit-driven private businesses that have legal agreements with provincial governments to harvest timber on Crown lands (Haley and Luckert 1990). Although the majority of Canadian forests are publicly-owned, forest management, harvesting, and other operations are primarily under the responsibility of the private forest companies, based on a wide range of legal agreements. Forest tenures are agreements between provincial governments and forest companies. These agreements transfer the rights for timber harvesting, in publicly-owned forests, to private forest companies, with some restrictions (Lee, Stanojevic, and Gysbers, 2003). These contractual agreements consider rights and duties, with the main forest company duties being to comply with forest-related laws and paying the associated fees. The main fee paid by forest companies is the stumpage fee, which is assessed per cubic meter of wood (Lee *et al.*, 2003).

Canadian provinces specify forest tenures in different ways, though some commonalties are also present. For instance, the area or volume of timber subject to harvest is specified, as is the duration of the forest tenure (Lee *et al.*, 2003). Every forest tenure has an 'annual allowable cut' (AAC) (i.e., the quantity of timber permitted to be cut, over time, from a particular area). In essence, an AAC is used to regulate harvest levels of timber (Ordre des Ingenieurs Forestieres du Quebec, 2003).

Commonly, forest tenure is renewed on a 5- or 10-year cycle for periods of approximately 25 years; however, a major event like a fire or uncontrolled pest or disease may provide a reason to re-evaluate the tenure and the AAC (National Forestry Database Program, 2004). Forest agreements and legislation associated with forest tenure in Canadian provinces and territories are presented in Table 3-3:

Table 3- 3 Forest Legislation and Forest Tenure Systems in Canadian Provinces and Territories
(Adapted from the National Forestry Database Program, 2004; and Lee *et al.*, 2003)

Province	Legislation	Tenure System
Newfoundland and Labrador	Forestry Act	Crown Timber Licences Domestic Cutting Permits Commercial Cutting Permits Timber Sale Agreements Operating Permits
Nova Scotia	Crown Lands Act and Forest Act	Long-term Licences Volume Utilization Agreements Tender Sales
New Brunswick	Crown Lands and Forests Act	Forest Management Agreements
Prince Edward Island	Forest Management Act	There is no tenure system because PEI has no Crown land as such. Nevertheless, cutting rights in Provincial Forest Sites are allocated to supply sawmills.
Quebec	Forest Act (new)	Timber Supply and Forest Management Agreements Forest Management Agreements Forest Management Contracts One-time Harvesting Agreements
Ontario	Crown Forest Sustainability Act	Sustainable Forest Licences Forest Resource Licences
Manitoba	Forest Act	Forest Management Licence Agreements Timber Sale Agreements Timber Permits
Saskatchewan	Forest Resources Management Act	Forest Management Agreements Term Supply Licences Forest Product Permits
Alberta	Forest Act	Forest Management Agreements Timber Permits Timber Quotas
British Columbia	Forest Act	Forest Licences Timber Sale Licences Pulpwood Agreements Free Use Permits Road Permits Community Forest Agreements Tree Farm Licences Timber Licences Woodlot Licences Licences To Cut Christmas Tree Permits
Yukon	n/a	There is no system similar to provincial forest tenures in Yukon. Nevertheless, commercial logging is controlled through Timber Permits.
Northwest Territories	Forest Act	There is no system similar to provincial forest tenures in NT; however, the NT Forest Management considers issuing permits and licences.

The establishment of Model Forests in Canada is an initiative to promote SFM. These initiatives approach forest management through building of a consensus and partnerships among stakeholders. Moreover, through new knowledge and technologies, that encourage ecologically sounder forest management practices, and promotes traditional knowledge, a network approach is promoted within Model Forests program (Natural Resources Canada, 2004). Model Forests were established in a process that included a nationwide competition, involving representatives of environmental organizations, forest companies, government, aboriginal peoples, and academia (Brand and LeClaire, 1994). The initiative has been possible because the federal government actively supported the process.

Model Forests use partnerships to focus on a vision of forest management. This vision includes a comprehensive set of values beyond timber production, and a collaborative work effort among different forest organizations (von Mirbach, 2000). Through this collaboration, Model Forests try to promote, whenever feasible, the path from traditional forest management to sustainable forest management – including production and environmental conservation – to enhance integrated forest management, and to transfer knowledge to resource managers while promoting the use of new technologies (International Model Forest Network, 2004a).

The core of a Model Forest is a group of partners, who have different positions and points of view on the economic, environmental, and social aspects of the forest. Periodically, the members meet to make decisions for improving sustainable forest management. Partners in this initiative include forest companies, Aboriginal communities, woodlot owners, federal and provincial governments, non-governmental organizations, environmentalists, universities, local communities, recreational groups, hunters, and trappers, among others.

Model Forests are seen as important tools for helping national forest programs and for evaluating the application of innovative forest management policies and practices

(International Model Forest Network, 2004b). With respect to the policies, the government has played a crucial role in this initiative. In fact, the government not only has given the necessary political support to promote them, but has contributed financial assistance for carrying out this new model of forest management (International Model Forest Network, 2004a).

In Canada, the Model Forest program has 11 model forests; the program is also active in 13 other countries. A list of the Canadian model forests is shown in Table 3-4:

Table 3- 4 Distribution of Model Forests in Canada
(Adapted from International Model Forest Network, 2004 b)

Model Forest	Size (ha)	Province
Foothills	2,750,000	Alberta
McGregor	7,700,000	British Columbia
Manitoba	1,048,000	Manitoba
Fundy	420,000	New Brunswick
Western Newfoundland	923,000	Newfoundland
Nova Forest Alliance	458,000	Nova Scotia
Lake Abitibi	1,200,000	Ontario
Eastern Ontario	1,530,000	Ontario
Bas St-Laurent	113,100	Quebec
Waswanipi Cree	3,300,000	Quebec
Prince Albert	360,000	Saskatchewan

3.4 Method: Content Analysis

This section discusses how content analysis was used as a method to guide the study of indicators applied by Model Forests and forest companies. Content analysis allows for the analysis of either explicit and implicit concepts or words within texts (Davis, 1997; Neuendorf, 2002). Moreover, it examines written texts and 'translates' the texts into categories (Weber, 1990).

Content analysis may be used to address issues where the study's object is a 'message' (Roberts, 1997). Through this method, the presence, significance, and relationships of words and concepts within texts, may be examined and their coherence with the related theory may be verified (Colorado State University, 2004). Thus, content analysis is a research technique that applies a *modus operandi* to establish conclusions from a text (Neuendorf, 2002; Weber, 1990).

This method can guide research by exploring the theories about the research topic, establishing a hypothesis or research question, and specifying a unit of analysis for the text being studied (Roberts, 1997; Weber, 1990). Variables must also be defined and a coding scheme developed (Neuendorf, 2002). The sample is then specified and all units of analysis within the sample are coded. Reliability measures and results must also be reported (Neuendorf, 2002).

Content analysis should be objective, systematic, and quantitative (Berelson, 1952). The objectivity requires that all stages in a research process be guided with a specific set of rules and principles; thus, minimizing the rater's subjectivity. The design of a codebook assists different raters to code an equal unit of text following an identical procedure (Kassarjian, 1977). Through systematization, the rules can be consistently applied by the inclusion and exclusion of analysis categories. As a result, the attributes that are relevant and important for the hypothesis are chosen and analyzed, and possible biases can be minimized (Kassarjian, 1977). Quantification requires that the collected data must be converted into measurable elements, to allow for the application of statistical methods (Kassarjian, 1977).

Content analysis must also address reliability and validity (Krippendorff, 1980; Neuendorf, 2002). Reliability is defined as the extent to which a measuring procedure yields the same result on repeated trials. In connection to reliability is the idea that if a measure can only be reproduced once by a particular person, then it is not important (Neuendorf, 2002). In the case where only one coder codes a text, the procedure should be repeated by the same coder. If the coder generates the same result, then reliability is achieved (Weber, 1990). To assess reliability, intra-rater reliability is calculated by the coefficient of agreement (Milne and Adler, 1999). The coefficient of agreement tests to see how repeatedly the rater coincides with the coding of texts under study. This coefficient is estimated as the number of identical matches divided by the total number of possible matches, or the ratio of coding agreements to the total number of coding taken by the same coder (Milne and Adler, 1999). Validity is considered as the extent to which a measuring procedure represents the intended concept, and only the intended concept. Therefore, we ask the question,"Are we measuring what we want to measure?" (Neuendorf, 2002 p. 112). Validity has two forms: face validity and external validity. Face validity is determined by the connection between what we intend to measure and what we are measuring. External validity is referred to as whether or not the findings of a content analysis can be generalized to other areas (Neuendorf, 2002).

3.5 Research Objective

This study was designed for two main objectives: to identify possible commonalties and differences in the ways by which Model Forests and forest companies construct indicators, and to assess which sustainability elements and criteria are emphasized by each group. In this section, the research questions, statistical methods, and data collection methods are described, and *a priori* expectations are presented.

3.5.1 Research Questions

The following research questions, related to the reviewed literature and the CCFM are addressed:

a) Questions related to the indicators of sustainability from the literature.

- Are the elements in Table 3-1 applied differently among the Model Forests and forest companies? Which of these elements are used more frequently by Model Forests and forest companies?

b) Questions related to the CCFM framework

- Are the CCFM criteria and elements in Table 3-2 used differently by the Model Forests and forest companies? Which CCFM criteria and elements are the most prevalent indicators among the Model Forests and forest companies?

To pursue these research questions, the level of analysis was established, and the ideas and concepts to be coded were chosen. The level of analysis was decided by selecting among the hierarchy of criteria, elements, and indicators. The hierarchical structure and examples of each term is described in Table 3-5.

The concepts that represented each indicator were coded at the indicator level (i.e., indicator-concepts), to gain an understanding of what Model Forests and forest companies are doing to implement SFM. In this research, a concept representing a given indicator was counted once for a given Model Forest or forest company. Content analysis was then conducted by investigating the presence of concepts, and not their quantity.

Table 3- 5 Definition and Examples of Criteria, Elements, Indicators, and Indicator-concepts

Factor	Definition	Example
Criterion	A criterion is characterized by a series of factors, conditions or processes by which sustainable forest management can be assessed.	Conservation of biological diversity
Element	An element is a common theme representing a group of indicators.	The criterion 'Conservation of biological diversity' has three elements: • Ecosystem diversity • Species diversity • Gene diversity
Indicator	An indicator is a quantitative or qualitative variable that measures an aspect of the criterion within a given element, and can be used to observe trends when observed periodically.	One of the indicators under the element 'Ecosystem diversity' is: • Percentage / extent, in area, of forest types relative to historical condition and to total forest area.
Indicator-concepts	Set of ideas and/or words that are related to a specific indicator	Concepts associated with the indicator *Percentage / extent, in area, of forest types relative to historical condition and to total forest area* may include: • Extent of variety and pattern of communities and ecosystems. • Area of forest ecosystems • Percentage and extent of area by forest type and age class • Area, percentage and representativeness of forest types in protected areas

For example, a hypothetical report from a forest company could yield 20 indicator-concepts. Based on these indicator-concepts, they are then classified by the SFM-associated elements. One might expect that every indicator-concept would be associated with one specific SFM element but, in reality, this is not the case. For example, a forest company that uses the indicator-concept, 'percent of forest type and age class managed primarily for soil and water protection,' might classify it under element 3.1 'physical environmental factors.' Nevertheless, this indicator-concept contains components that could also belong to element 1.1 'ecosystem diversity.' Thus, this indicator-concept would be coded under the respective elements of both criteria, making it possible for one indicator-concept to be counted under more than one SFM-associated element.

To carry out the conceptual analysis of indicators, a codebook and a coding form were created (see Appendix B). The codebook includes concepts associated with criteria and elements, and contains all concepts to be recorded during the coding process. The coding form is used to record the results from the content analysis, as well as to transfer the results to a database for quantification (Neuendorf, 2002).

Objectivity was pursued by following the codebook containing concepts associated with SFM criteria and elements. Moreover, systematization was observed by using the coding form, and quantification was made possible by coding the concepts.

To assess reliability of the coding, the indicator-concept coding was repeated three times. The coding process was repeated to minimize the variance in the coding of text and increase the coefficient of agreement, which measures the number of identical matches between the different rounds of coding.

This case study analyzed 627 indicator-concepts, each of which was screened using a codebook containing 106 concepts. All 627 indicator-concepts were analyzed, regardless of whether or not they included any of the 106 concepts. When an indicator-concept contained a concept from the codebook, a "1" was assigned in the coding process. By contrast, a "0" was assigned when no concepts appear in indicator-concepts. If we consider all "0" and "1" codings, then 66,462 components were classified (627 indicators x 106 concepts). In this case, the coefficient of agreement increased from 98% to 99% between the second and third codings. However, it could be argued that many of the "0" codings were obvious, and therefore should not be counted in a reliability estimate. If we consider only "1" codings, then 6,897 components were classified. In this situation, and for the second coding, 5,052 components were matched with the first codings, and the coefficient of agreement was calculated to be 73%. In the third coding, 6,387 components were matched with the first coding, and the coefficient of agreement was 92%. In this case study, the statistical analysis was applied to the outcome after the third coding, as the coefficient of agreement was greater.

To test validity, four individuals with expertise on criteria and indicators of SFM were consulted and asked to validate the codebook (the list of professionals is presented in Appendix C).

3.5.2 Data Collection

The data in this analysis was derived from the model forests and forest companies in Canada that use indicators to assess their progress towards SFM. An Internet search that included 45 forest companies and all of the 11 model forests Web sites was conducted from September 2003 to May 2004. The sample (n=12) was small because the empirical analysis considers only model forests and forest companies with information about their C&I set that is publicly available either on the Internet or from the forest managers. In addition, to be included in the analysis, C&I data sets must use the CCFM framework for structuring the criteria. Data was also received from Ms. Cindy Pearce[4].

The sample comprises five model forests and seven forest companies located in Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, and Ontario. A list of the model forests and forest companies is provided in Table 3-6:

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[4] Personal communication with Ms. Cindy Pearce, Registered Professional Forester and consultant in BC. September 2003.

Table 3- 6 List of Model Forests and Forest Companies (by Province)

Province	**Model Forests**
Alberta	Foothills
British Columbia	Mc Gregor
New Brunswick	Fundy
Nova Scotia	Nova Forest Alliance
Ontario	Lake Abitibi
Province	**Forest Companies**
Alberta	Canfor Grande Prairie
British Columbia	Stillwater timberlands unit BC coastal group Weyerhaeuser
	Canfor Prince George
	Canfor Chetwynd
	Canfor Englewood
Ontario	Fort Frances Abitibi
	Ontario East Woodlands Division Abitibi

A map showing the location of model forests and forest companies used in this study is presented in Figure 3-1:

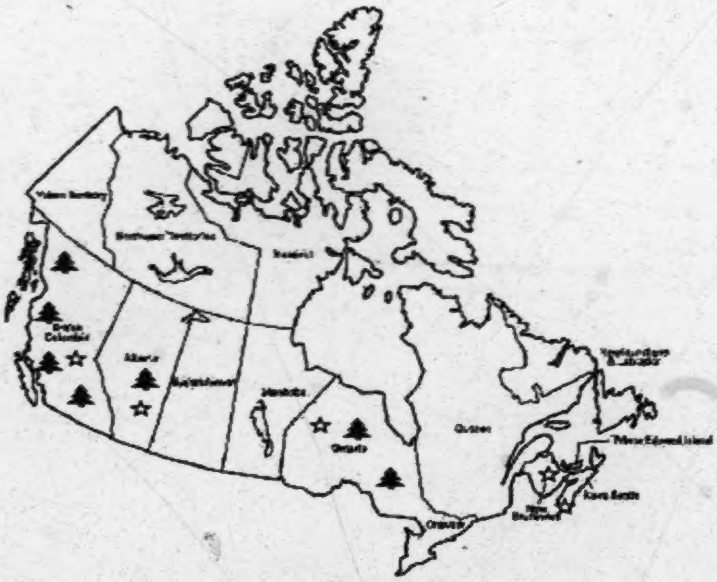
British Columbia
Alberta
Manitoba
Ontario
Quebec
Prince Edward Island
Nova Scotia
New Brunswick

Figure 3-1 Distribution of Model Forests and Forest Companies in Canada used in this study.
(Map adapted from Natural Resources Canada, 2005)

🌲 = Represents forest companies **☆ = Represents Model Forests**

3.5.3 Statistical Analysis

Content analysis results for model forests and forest companies were compared using statistical analyses. The data was analyzed using SPSS 11.1 for Windows (Statistical Package for the Social Sciences, Inc., Chicago IL, USA) and Microsoft Excel® 2000.

The sample was not normally distributed and the size was small (n=12, 5 model forests and 7 forest companies). In addition, the collection method was not random, and the data was expressed in proportions instead of absolute numbers. Given these characteristics of the data, nonparametric procedures were used for the analysis. Statistical procedures were applied within and between groups (i.e. model forests and forest companies), and for the pooled data.

In this case study, three different types of statistical analyses[5] were carried out:

i) To test for differences in proportions of indicator-concepts within a given element and within a given group (i.e. within forest companies, within Model Forests, and within the pooled sample), a Chi-squared ($\chi 2$) test for differences in n proportions (independent samples) was used (Berenson and Levine, 1996).

The χ^2 test statistic is:

$$\chi^2 = \sum_{i=1}^{n} \frac{(p_i - p_e)^2}{p_e}$$

Where pi is the observed proportion of indicator-concepts for a given SFM-associated element addressed by a given model forest or forest company; and pe is the expected proportion in the same sample.

---

[5] All of these tests were reported at the 5% or the 10% levels of significance.

In this statistical test, the null hypotheses (H_o) of no differences among proportions of indicator-concepts within a given group (i.e. within forest companies, or within Model Forests, or within a pooled sample) is:

$$H_O : p_1 = p_2 = p_3 = ... = p_i \quad \text{with } i = 1,2,3,...n$$

This is tested against the alternative hypothesis, H_A, that not all proportions are similar:

$$H_A : p_1 \neq p_2 \neq p_3 \neq .... \neq p_i \quad \text{with } i = 1,2,3,...n$$

ii) To assess differences among the proportion of indicator-concepts associated with elements within a given group (i.e. within forest companies, within Model Forests, and within pooled samples) the Mann-Whitney U-test[6] and the Kruskal–Wallis test were used. These tests are applied when data is either ordinal or when normality assumptions are not satisfied (Berenson and Levine, 1996; Siegel and Castellan, 1988).

If proportions of indicator-concepts associated with two SFM-associated elements were compared, then the Mann-Whitney U-test was used (Siegel and Castellan, 1988). This is a non-parametric procedure used for assessing differences between two parameters established by the analysis of two independent samples.

The Mann-Whitney test has a null hypothesis of no differences between two medians of population within a given group (i.e. within forest companies, within Model Forests, or within a pooled sample). The null hypothesis is:

$$H_O : M_1 = M_2$$

This is tested against the alternative hypothesis that medians are different.

$$H_A : M_1 \neq M_2$$

---

[6] This test is equivalent to the Wilcoxon-Rank sum test (Berenson and Levine, 1996)

In this test, *Mj* (j=1,2) is the median value of proportions of indicator-concepts associated with a given SFM-associated element. Depending on the sample size, this test may follow two procedures (Table 3-7).

Table 3-7 Mann-Whitney U test

Sample Size	Test	Definition
Each sample (n_1 and n_2) is ≤ 10	$T_1 + T_2 = {n(n+1)}/{2}$	Where T_1 is the sum of the ranks assigned to n_1, and T_2 is the sum of the ranks assigned to n_2.
Each sample (n_1 and n_2) is > 10	$Z = {(T_1 - \mu T_1)}/{\sigma T_1}$	Where T_1 is the sum of the ranks assigned to n_1, $\mu T1$ is mean value of T_1, and σ T1 is standard deviation of T_1.

To conduct this test, observations (in this case, percentages) from sample 1 and 2 are brought together into a single set of size n=n1+n2. Next, these observations are ranked from the lowest (rank=1) to the highest (rank=n). Thus, the Mann-Whitney test replaces original observations with ranks, to bring attention to the ordinal relationships among them (Siegel and Castellan, 1988). Finally, the statistical procedure is applied. The Mann-Whitney null hypothesis does not test whether or not the ranks are different, but tests whether or not the medians from sample 1 and 2 are different, and whether or not they come from the same population.

If proportions of indicator-concepts associated with three or more SFM-associated elements were compared, then the Kruskal–Wallis test was used (Siegel and Castellan, 1988). As in the Mann-Whitney test, this statistical test is based on replacing observations by ranks. In fact, the Kruskal-Wallis test applies the same logic as used in the Mann-Whitney test, but in situations when more than two parameters must be compared (Berenson and Levine, 1996).

The Kruskal–Wallis null hypothesis of no differences among medians of population within a given group (i.e. within forest companies, within Model Forests, and within a pooled sample) is as follows:

$$H_O : M_1 = M_2 = M_3 = ... = M_j \quad \text{with } j = 1,2,3,...n$$

Which is tested against the alternative hypothesis, HA that medians are different,

$$H_A : M_1 \neq M_2 \neq M_3 \neq ...... \neq M_j \quad \text{with } j = 1,2,3,...n$$

In this test, M_j (j=1,2...n) is the median value of a proportion of indicator-concepts associated with a given SFM-associated element.

In this statistical procedure, the following Kruskal-Wallis test statistic was used:

$$H = \left\{ \frac{12}{n(n+1)} \sum_{j=1}^{n} \frac{T_j^2}{n_j} \right\} - 3(n+1)$$

Where Tj2 is the square of the sum of the ranks assigned to the jth sample, and nj is the number of observations in the jth sample (Berenson and Levine, 1996).

If the null hypothesis in the Kruskal-Wallis test is rejected, then differences exist among the proportions of indicator-concepts associated with SFM-associated elements. For these cases, a Dunn's test procedure was applied. Dunn's procedure is a non-parametric post-hoc test that makes pairwise (multiple) comparisons simultaneously (Berenson and Levine, 1996; Sprent, 2001).

To apply this procedure, the following values must be computed:

$$R_j = \frac{T_j}{n_j} \quad ; \; R_{j'} = \frac{T_{j'}}{n_{j'}}$$

Where Rj is the average rank for the jth group; Rj' is the average rank for the pair to be compared for the j'th group; Tj is the sum of the ranks assigned to the jth sample; T'j is the sum of the ranks assigned to the pair to be compared to the j'th sample; nj is the number of observations in the jth sample; and n'j is the number of observations in the pair to be compared in the j'th sample. The differences for every pair of average ranks are then estimated and compared with the critical range from Dunn's procedure (Berenson and Levine, 1996):

$$\text{Critical range} = Z_u * \sqrt{\left\{\frac{n(n+1)}{12}\left[\frac{1}{n_j}+\frac{1}{n_{j'}}\right]\right\}}$$

Where Zu is the critical value from the standardized normal distribution for an α significance level, and n is the total number of observations; and where nj and n'j are described above. If the differences for every pair of average ranks are greater than the critical range, then that specific pair is significantly different (Berenson and Levine, 1996). In this study, Dunn's procedure is reported at the 5% and 10% levels of significance.

iii) To assess whether or not SFM-associated elements are different in the Model Forests and the forest companies, the Mann-Whitney U-test was used, as described above (Siegel and Castellan, 1988).

3.5.4 *A Priori* Expectations

Model forests and forest companies exhibit some similarities. Both groups are mainly based on Crown land, which might promote the consideration of non-timber values (non-market goods and services). Furthermore, since forest companies participate in Model Forest initiatives across Canada, large differences would not be expected to be seen between the groups. The main difference might be that model forests emphasize innovation and the participation of stakeholders in their forest management, and are partially federally funded. Thus, model forests are oriented to promote novel approaches in forest management, and to enhance partnerships with surrounding land managers. In addition, model forests might have a more complete forest vision by having greater participation of different stakeholders (i.e., aboriginal and forest communities, researchers, industry, and governments, etc.) in their planning. In contrast, forest companies may have a narrower range of stakeholders in their forest planning, and therefore, might have a forest vision that is less holistic than that of the model forests. Thus, participation and joint decision-making may be more strongly present in model forests, compared to the forest companies. In addition, and as a result of the vision of the multi-stakeholders, model forests are likely to incorporate other values besides timber, and might include more social- and environmental-oriented criteria.

3.6 Results

The outcome of the content-analyses and statistical analyses are provided in this section. To protect the identities of individual organizations, model forests were coded with letters (A to E), and forest companies were coded with numbers (1 to 7).

The proportion of indicator-concepts varies among the model forests and forest companies. The number of indicator-concepts reviewed for each model forest and forest company is presented in Table 3-8:

Table 3- 8 Number of Indicator-Concepts Reviewed by Model Forest and Forest Company

Model Forest	Number of Indicator-Concepts
A	65
B	45
C	36
D	24
E	39
Total Model Forests	209
Forest Company	
1	111
2	52
3	48
4	73
5	44
6	38
7	52
Total Forest Companies	418
Total Model Forests and Forest Companies	627

3.6.1 Questions Related to the Literature Review of Indicators of Sustainability

Equity Criterion

Table 3.9 shows the proportion of indicator-concepts[7] associated with inter-generational and intra-generational elements, which are contained in the Model Forests and forest companies. From the table, little variation is seen among the proportions within the Model Forests and forest companies. Chi-square test results[8] show no significant differences ($p>0.05$) for either the SFM-associated elements within a group or the pooled samples (Table D-1a).

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[7] In Tables 3-9 through 3-25, $\bar{n}$ indicates the average number of indicator-concepts by group, where the respective SFM-associated element was observed.

[8] All subsequent Tables labelled 'Table D-X' are contained in Appendix D, and contain results from different statistical analyses applied to elements and criteria.

Table 3- 9 Percentages of Indicator-concepts Related to each SFM-associated Element of the Equity Criterion

Observation	Equity Criterion	
	Inter-generational element (%)	Intra-generational element (%)
Model Forest		
A	88	12
B	90	10
C	92	8
D	90	10
E	83	17
Average Model Forests	**89 ($\bar{n}$ =39)**	**11 ($\bar{n}$ =5)**
Forest Companies		
1	96	4
2	95	5
3	93	7
4	97	3
5	94	6
6	94	6
7	94	6
Average Forest Companies	**95 ($\bar{n}$ =53)**	**5 ($\bar{n}$ =3)**
Average Total	**92 ($\bar{n}$ =47)**	**8 ($\bar{n}$ =3)**

A greater percentage of equity indicator-concepts are related to inter-generational equity, rather than the intra-generational equity element. The Mann-Whitney test showed that these percentages are different ($p<0.05$) for both elements within a group (Table D-1b). In addition, the data shows that Model Forests include a lower percentage of inter-generational indicator-concepts, compared to forest companies, and Model Forests thus have a higher percentage of the intra-generational indicator-concepts, compared to forest companies. The Mann-Whitney tests also showed that these proportions are significantly different ($p<0.05$) for the Model Forests compared to the forest companies (Table D-1c). The distribution of these elements in Model Forests and forest companies is shown in Figure 3- 2[9]:

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[9] In all subsequent graphs, the acronyms are defined as follows Average in Model Forests (AvMF), Average in Forest Companies (AvFC), Average for both groups (AvBoth)

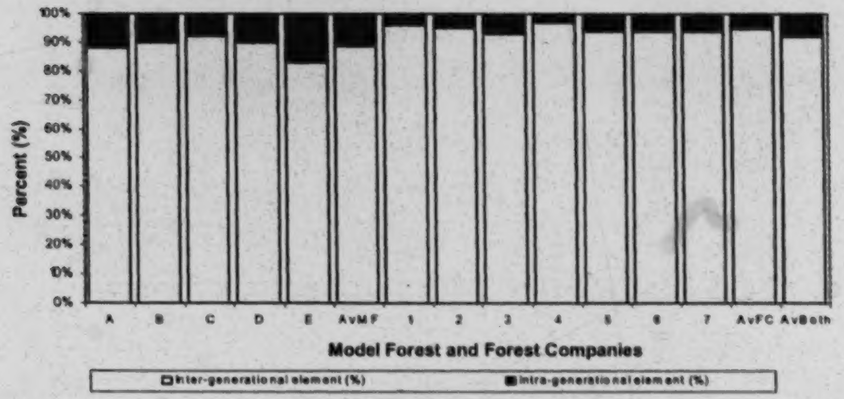

Figure 3-2 Percentage Distribution of the Equity Criterion SFM-associated Elements among the Model Forests and Forest Companies

Sustainability Criterion

Table 3-10 presents the percentage of indicator-concepts associated with economic, environmental, and social SFM-associated elements. In the table, variation among the proportions within both groups is low for all elements. Chi-square tests confirm this observation and show no significant differences (p>0.05), in these SFM-associated elements within a group or in the pooled sample (Table D-2a).

Table 3-10 Percentages of Indicator-concepts Related to each SFM-associated Element of the Sustainability Criterion

Observation	**Sustainability Criterion**		
	Economic element (%)	**Social element (%)**	**Environmental element (%)**
Model Forests			
A	48	18	34
B	48	17	35
C	47	17	36
D	48	11	41
E	48	19	33
Average Model Forests	**48 ($\bar{n}$ =20)**	**16 ($\bar{n}$ =7)**	**36 ($\bar{n}$ =15)**
Forest Companies			
1	44	21	35
2	42	16	42
3	46	12	43
4	49	14	37
5	50	13	37
6	48	15	37
7	48	8	44
Average Forest Companies	**47 ($\bar{n}$ =28)**	**14 ($\bar{n}$ =9)**	**39 ($\bar{n}$ =23)**
Average Total	**47 ($\bar{n}$ =24)**	**15 ($\bar{n}$ =8)**	**38 ($\bar{n}$ =20)**

A high proportion of indicator-concepts is associated with economic sustainability, compared to environmental sustainability or social sustainability. The Kruskal–Wallis test shows that significant differences ($p<0.05$) are present among these elements within the groups (Table D-2b). Dunn's test was performed to determine which elements differed significantly from each other. Results are shown in Table 3-11[10].

Table 3- 11 Dunn's Test Outcome in Sustainability Criterion

	Model Forests		Forest Companies		Pooled Data	
	ECON	ENV	ECON	ENV	ECON	ENV
ECON	N/A		N/A		N/A	
ENV	—	N/A	—	N/A	**	N/A
SOC	**	—	**	*	**	**

ECON=Economic, ENV=Environmental, SOC=Social

Results from Dunn's test shows that, at a 5% level of significance, 'economic sustainability' is significantly different then the 'social sustainability' element in all groups. In addition, at the 5% level of significance, 'economic sustainability' is significantly different then 'environmental sustainability,' and 'environmental sustainability' is significantly different then 'social sustainability' in the pooled data. Finally, at a 10% level of significance, 'environmental sustainability' is significantly different then 'social sustainability' in the forest companies.

Furthermore, the data shows that Model Forests include a slightly higher percentage of the 'economic sustainability' and the 'social sustainability' elements, compared to the forest companies. Consequently, forest companies have a higher percentage of the 'environmental sustainability" element, compared to the Model Forests. In fact, the Mann-Whitney U test shows that significant differences are found in applying the 'environmental sustainability' element ($p<0.05$) between Model Forests and forest companies (Table D-2c).

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[10] In all of Dunn's table results, '—' indicates no significant differences, '**' indicates significant differences at the 5% level, and '*' indicates significant differences at the 10% level.

The distribution of these elements in the Model Forests and forest companies is shown in Figure 3-3:

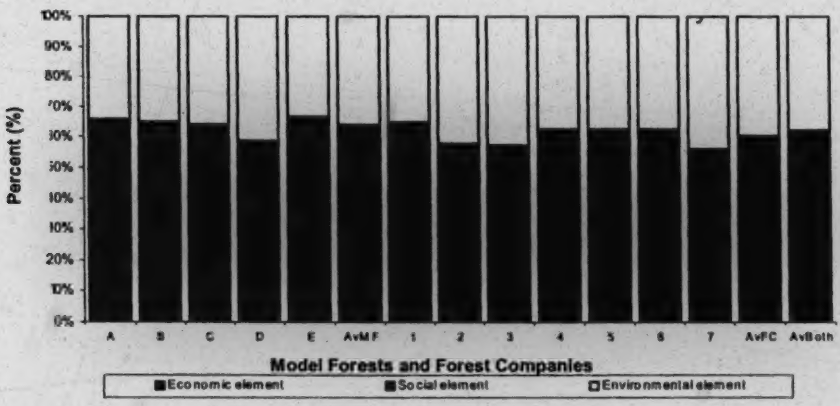

Figure 3- 3 Percentage Distribution of Sustainability Criterion SFM-associated Elements among Model Forests and Forest Companies

Level Criterion

Table 3-12 shows the proportions of indicator-concepts associated with community and provincial-regional level SFM-associated elements. In the table, the variation in the proportions within each group is small. Chi-square tests confirmed that no significant differences ($p>0.05$) for each element were present within either group or the pooled sample (Table D-3a).

Table 3- 12 Percentages of Indicator-concepts Related to each SFM-associated Element of the Level Criterion

Observations	**Level Criterion**	
	Community element (%)	**Regional-Provincial element (%)**
Model Forests		
A	90	10
B	91	9
C	93	7
D	79	21
E	91	9
Average Model Forests	**89 ($\bar{n}$ =9)**	**11 ($\bar{n}$ =1)**
Forest Companies		
1	97	3
2	93	7
3	94	6
4	96	4
5	97	3
6	96	4
7	97	3
Average Forest Companies	**96 ($\bar{n}$ =22)**	**4 ($\bar{n}$ =1)**
Average Total	**93 ($\bar{n}$ =17)**	**7 ($\bar{n}$ =1)**

The data also illustrates that greater proportions of indicator-concepts are associated with the community level compared to the regional-provincial level elements. The Mann-Whitney test of significance showed that these percentages are different ($p<0.05$) for both elements within all groups (Table D-3b). In addition, the data shows that Model Forests tend to have a slightly lower percentage of 'community' element, compared to the forest companies, and Model Forests have a higher percentage of the 'regional-provincial' element, compared to the forest companies. Mann-Whitney tests also showed that these proportions are significantly different ($p<0.05$) in the Model Forests, compared to the forest companies (Table D-3c).

The distribution of these elements in the Model Forests and forest companies is shown in Figure 3-4:

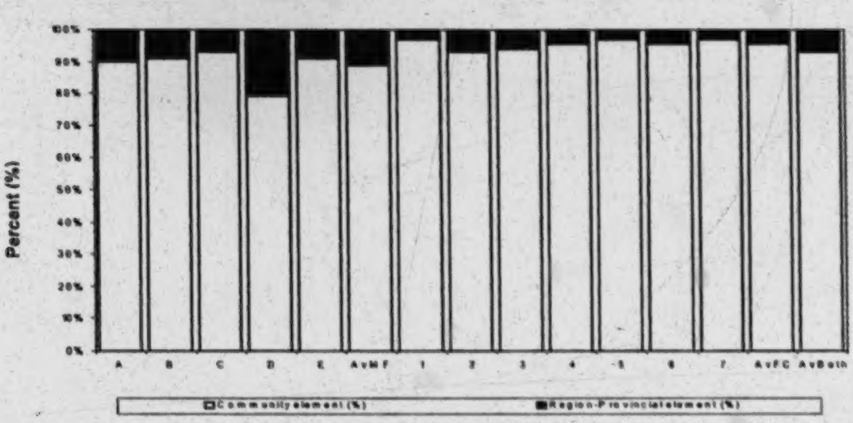

Figure 3-4 Percentage Distribution of the Level Criterion SFM-associated Elements among Model Forests and Forest Companies

Ecosystem Goods & Services Criterion

Indicator-concepts associated with addressing ecosystem goods and services were classified according to two SFM-associated elements: 'addressing ecosystem goods and services,' and explicitly 'accounting for ecosystem goods and services.' The second element is a subset of the first element in terms of the *number* of indicator-concepts associated with each element. Numbers of indicator-concepts, as opposed to percentages, are shown because of the very low incidence of indicator-concepts associated with the accounting element (Table 3-13):

Table 3-13 Number of Indicator-Concepts Associated with the Ecosystem Goods & Services Criterion

Observations	Ecosystem Goods & Services Criterion	
	Address ecosystem goods and services element (number)	Account ecosystem goods and services element (number)
Model Forests		
A	8	2
B	4	0
C	4	1
D	3	0
E	6	1
Average Model Forests	**5**	**1**
Forest Companies		
1	13	1
2	8	1
3	5	0
4	11	0
5	5	0
6	5	0
7	7	0
Average Forest Companies	**8**	**0**
Average Total	**7**	**0.5**

Because ‘accounting for ecosystem goods and services’ is a subset of ‘addressing ecosystem goods and services,’ the statistical analyses were not performed. Importantly, however, addressing ecosystem goods and services has not yet progressed to the point where firms are accounting for these goods and services.

3.6.2 Questions Related to the CCFM Framework

To test for differences in applying CCFM criteria and elements among Model Forests and forest companies, the same statistical tools were used as were applied to the research questions for the literature review on indicators of sustainability. In this case, they were first applied at the criteria level rather than at the element level.

CCFM Criteria

Table 3-14 provides the proportions of indicator-concepts related to CCFM criteria. In the table, substantial variability is seen in the proportions within each group, and the CCFM criteria do not seem to be addressed in the same way in the Model Forests and forest companies. Among the forest companies, the Chi-square tests demonstrated significant differences ($p<0.05$) for the criteria ‘conservation of soil and water resources,’ ‘multiple benefits to society,’ and ‘accepting society’s responsibility for sustainable development’ (Table D-4a). In addition, significant differences are seen among the Model Forests and in the pooled data with the criterion ‘multiple benefits to society.’

Table 3-14 Percentages of Indicator-concepts Related to each Criterion of the CCFM Criteria

OBSERVATION	CCFM CRITERIA					
	1. Biological diversity (%)	**2. Forest ecosystem productivity (%)**	**3.Conservation of soil and water (%)**	**4.Contribution to global ecological cycles (%)**	**5.Multiple benefits to society (%)**	**6.Accepting society's responsibility (%)**
Model Forests						
A	11	13	8	9	43	16
B	27	12	11	9	21	20
C	14	14	9	17	33	13
D	16	17	16	17	19	15
E	17	13	10	8	40	12
Average Model Forests	**17 ($\overline{n}$ =14)**	**14 ($\overline{n}$ =10)**	**11 ($\overline{n}$ =9)**	**12 ($\overline{n}$ =10)**	**31 ($\overline{n}$ =27)**	**15 ($\overline{n}$ =13)**
Forest Companies						
1	10	13	19	9	21	28
2	12	12	12	12	32	20
3	12	17	8	11	38	14
4	14	10	21	21	26	8
5	21	9	28	14	13	15
6	19	9	12	17	23	20
7	16	17	9	17	29	12
Average Forest Companies	**15 ($\overline{n}$ =18)**	**12 ($\overline{n}$ =16)**	**16 ($\overline{n}$ =22)**	**14 ($\overline{n}$ =18)**	**26 ($\overline{n}$ =36)**	**17 ($\overline{n}$ =23)**
Average Total	**16 ($\overline{n}$ =16)**	**13 ($\overline{n}$ = 14)**	**14 ($\overline{n}$ =17)**	**13 ($\overline{n}$ =15)**	**28 ($\overline{n}$ =32)**	**16 ($\overline{n}$ =19)**

The Kruskal–Wallis tests of significance demonstrated that all CCFM criteria were different within the Model Forests ($p<0.1$), the forest companies, and the pooled data ($p <0.05$) (Table D-4b). Therefore, Dunn's test was applied to assess which elements differed significantly from each other (Table 3-15).

Table 3-15 Dunn's Test Outcome for CCFM Criteria

	Model Forests					Forest Companies					Pooled Data				
Element	**BD**	**EP**	**S&W**	**GEC**	**MBS**	**BD**	**EP**	**S&W**	**GEC**	**MBS**	**BD**	**EP**	**S&W**	**GEC**	**MBS**
BD	N/A					N/A					N/A				
EP	---	N/A				—	N/A				---	N/A			
S&W	---	---	N/A			—	—	N/A			---	---	N/A		
GEC	---	---	---	N/A		—	—	---	N/A		---	---	---	N/A	
MBS	---	---	---	**	N/A	—	**	---	---	N/A	*	**	**	**	N/A
SR	---	---	---	---	---	—	—	---	---	---	---	---	---	---	*

BD= Biological diversity, EP= Forest ecosystem productivity, S&W= Conservation of soil and water, GEC= Contribution to global ecological cycles, MBS= Multiple benefits to society, SR= Accepting society's responsibility

The results of Dunn's test showed that at a 5% level of significance, 'multiple benefits to society' is significantly different then 'forest ecosystems contribution to ecological cycles' in the Model Forests and the pooled data. Similarly, at a 5% level of significance, 'multiple benefits to society' is significantly different then 'maintenance and enhancement of forest ecosystem condition and productivity' in the forest companies and the pooled data. Furthermore, in the pooled data, the same criterion is significantly different then at a 5% level of significance over the 'conservation of soil and water resources.' In addition, within pooled data, this criterion, at a 10% level of significance, is significantly different then 'conservation of biological diversity' and 'accepting society's responsibility for sustainable development.'

Furthermore, the data showed that Model Forests have a slightly higher proportion of indicator-concepts associated with 'biological diversity,' 'forest ecosystem productivity,' and 'multiple benefits to society' criteria, compared to those associated with forest companies. On the other hand, forest companies have a higher percentage of 'conservation of soil and water,' 'contribution to global ecological cycles,' and 'accepting society's responsibility' criteria, compared to the Model Forests. However, the Mann-Whitney U test showed no significant differences among these criteria for the Model Forests and the forest companies (Table D-4c).

The distribution of CCFM criteria by Model Forests, forest companies, and their respective averages are shown in Figures 3-5, 3-6, and 3-7:

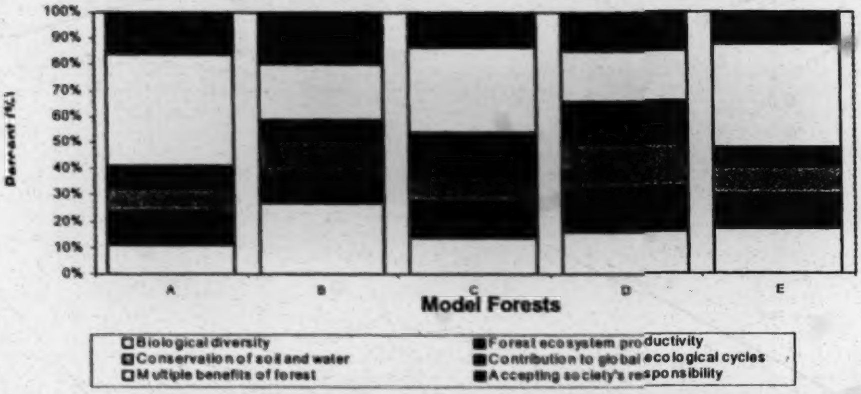

Figure 3-5 CCFM Criteria Distribution (by Model Forests)

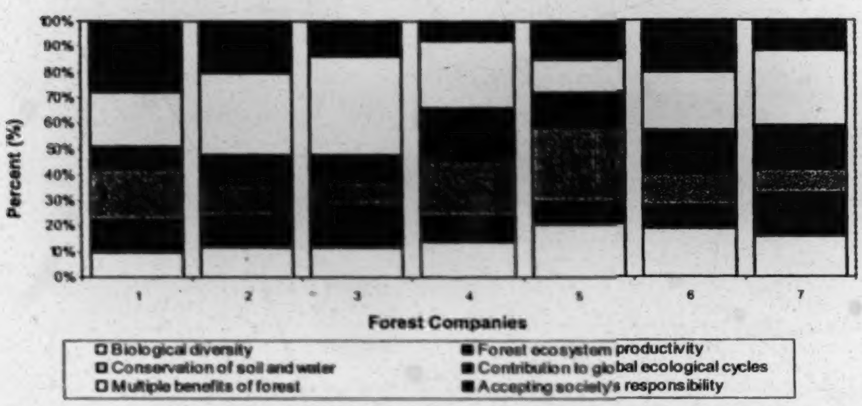

Figure 3-6 CCFM Criteria Distribution (by Forest Companies)

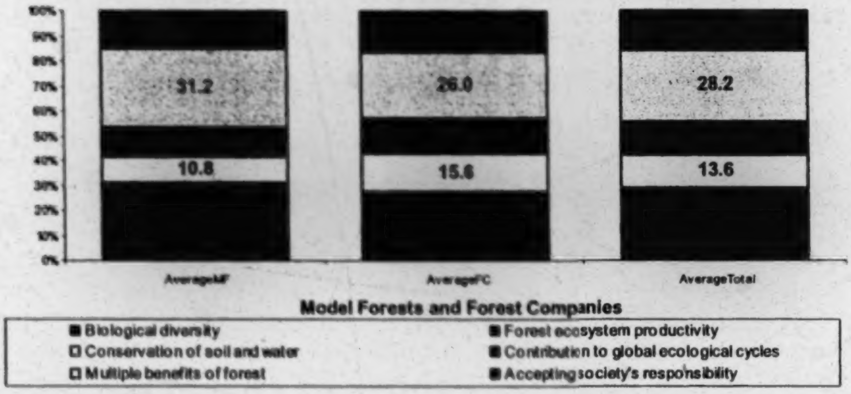

Figure 3-7 CCFM Average Percentage Criteria Distribution in Model Forests, Forest Companies and Pooled Data

Criterion #1 Conservation of Biological Diversity

Table 3-16 shows the proportions of indicator-concepts related with elements of the biological diversity criterion. In this table, the variation of proportions within each group is low. Chi-square tests showed that no significant differences ($p>0.05$) exist in these elements within a group or in the pooled sample (Table D-5a).

Table 3-16 Percentages of Indicator-concepts Related to each SFM-associated Element of the Conservation of Biological Diversity Criterion

Observations	**Criterion # 1 Conservation of biological diversity**		
	Ecosystem diversity element (%)	**Species diversity element (%)**	**Gene diversity element (%)**
Model Forests			
A	69	15	15
B	61	35	4
C	73	18	9
D	67	22	11
E	54	38	8
Average Model Forests	**65 ($\overline{n}$ =9)**	**26 ($\overline{n}$ =4)**	**10 ($\overline{n}$ =1)**
Forest Companies			
1	70	25	5
2	65	29	6
3	58	33	8
4	56	37	7
5	61	28	11
6	67	25	8
7	71	24	6
Average Forest Companies	**64 ($\overline{n}$ =11)**	**29 ($\overline{n}$ =5)**	**7 ($\overline{n}$ =1)**
Average Total	**64 ($\overline{n}$ =10)**	**27 ($\overline{n}$ =5)**	**8 ($\overline{n}$ =1)**

Moreover, a greater proportion of indicator-concepts was associated with the 'ecosystem diversity' element compared to 'species diversity' or 'gene diversity' elements. The Kruskal–Wallis tests of significance established that these elements are different ($p<0.05$) within the groups (Table D-5b). In addition, Dunn's test was conducted to assess which elements differed significantly from each other (Table 3-17).

Table 3-17 Dunn's Test Outcome for Conservation of Biological Diversity SFM-associated Elements

	Model Forests		**Forest Companies**		**Pooled Data**	
Element	**ED**	**SD**	**ED**	**SD**	**ED**	**SD**
ED	N/A		N/A		N/A	
SD	---	N/A	*	N/A	**	N/A
GD	**	---	**	*	**	**

ED=Ecosystem diversity, SD=Species diversity, GD=Gene diversity

The results of Dunn test showed that at a 5% level of significance, 'ecosystem diversity' is significantly different then 'gene diversity' element in all groups. Furthermore, at a 5% level of significance, 'ecosystem diversity' is significantly different then elements of 'species diversity' and 'gene diversity' in the pooled data. In forest companies, however, at a 10% level of significance, 'ecosystem diversity' is significantly different then element 'species diversity', and 'species diversity' is significantly different then element 'gene diversity.'

The data showed that Model Forests have a slightly higher percentage of indicator-concepts associated with 'ecosystem diversity' and 'gene diversity,' compared to the forest companies. Correspondingly, forest companies have a higher percentage of indicator-concepts associated with the 'species diversity' element, compared to the Model Forests. Nevertheless, the Mann-Whitney U test did not show that these percentages were significantly different between Model Forests and the forest companies (Table D-5c).

The distribution of these elements in the Model Forests and the forest companies is shown in Figure 3-8:

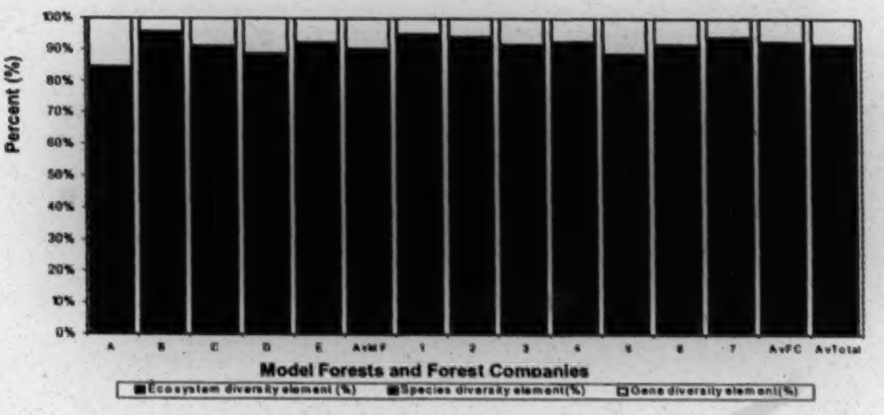

Figure 3-8 Percentage Distribution of the Conservation of Biological Diversity SFM-associated Elements among Model Forests and Forest Companies

Criterion #2 Maintenance and Enhancement of Forest Ecosystem Conditions and Productivity

Table 3-18 illustrates the proportions of indicator-concepts related to the elements of 'forest ecosystem condition and productivity' criterion. The variations of proportions within each group are not high. Chi-square tests also demonstrated that no significant differences (p>0.05) were present in the SFM-associated elements within groups or the pooled sample (Table D-6a).

Table 3-18 Percentages of Indicator-concepts Related to each SFM-associated Element of the Maintenance and Enhancement of Forest Ecosystem Condition and Productivity Criterion

Observations	Criterion # 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity		
	Stress and disturbance element (%)	Ecosystem resilience element (%)	Extent biomass element (%)
Model Forests			
A	33	60	7
B	20	60	20
C	9	64	27
D	10	70	20
E	30	60	10
Average Model Forests	**21 ($\bar{n}$ =2)**	**63 ($\bar{n}$ =7)**	**17 ($\bar{n}$ =1)**
Forest Companies			
1	35	58	8
2	23	71	6
3	21	74	5
4	21	68	10
5	12	75	12
6	17	67	17
7	17	78	6
Average Forest Companies	**21 ($\bar{n}$ =4)**	**70 ($\bar{n}$ =11)**	**9 ($\bar{n}$ =1)**
Average Total	**21 ($\bar{n}$ =3)**	**67 ($\bar{n}$ =9)**	**12 ($\bar{n}$ =1)**

A large proportion of indicator-concepts was associated with the ‘ecosystem resilience’ element, compared to the ‘stress and disturbance’ or the ‘extent of biomass’ elements. The Kruskal–Wallis tests of significance demonstrated ($p<0.05$) that these elements are different within groups (Table D-6b). Dunn’s test was used to determine which elements differed significantly from each other under this criterion (Table 3-19).

Table 3-19 Dunn’s Test Outcome for Maintenance and Enhancement of Forest Ecosystem Condition and Productivity SFM-associated Elements

	Model Forests		Forest Companies		Pooled Data	
Element	**SD**	**ER**	**SD**	**ER**	**SD**	**ER**
SD	N/A	---	N/A	---	N/A	---
ER	**	N/A	*	N/A	**	N/A
EB	—	**	—	**	---	**

SD= Stress and disturbance, ER= Ecosystem resilience, EB=Extent biomass

The results of Dunn’s test indicated that, at a 5% level of significance, ‘ecosystem resilience’ is significantly different then ‘stress and disturbance’ and ‘extent of biomass’ in the Model Forests and the pooled data. However, in forest companies, at a 5% level of significance, ‘ecosystem resilience’ is significantly different then ‘extent of biomass,’ and at a 10% level of significance ‘ecosystem resilience’ is significantly different then ‘stress and disturbance’ element.

In addition, the data shows that forest companies have a slightly higher proportion of the ‘ecosystem resilience’ element, compared to the Model Forests. In contrast, Model Forests have a higher percentage of ‘extent of biomass,’ compared to the forest companies. A Mann-Whitney U test shows that ‘ecosystem resilience’ and ‘extent of biomass’ elements are significantly different between Model Forests and forest companies (Table D-6c).

The distribution of these elements for this criterion in the Model Forests and forest companies is shown in Figure 3-9:

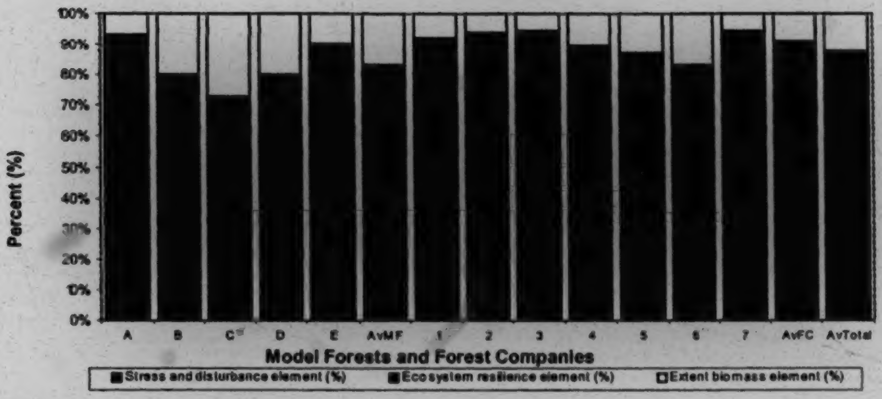

Figure 3-9 Percentage Distribution of the Maintenance and Enhancement of Forest Ecosystem Condition and Productivity SFM-associated Elements among Model Forests and Forest Companies

Criterion #3 Conservation of Soil and Water Resources

Table 3-20 shows the proportion of indicator-concepts related to the elements of the 'conservation of soil and water resources' criterion. In the table, variation among these proportions is seen to be low within each group. Chi-square tests showed no significant differences ($p > 0.05$) for elements within either group or in the pooled sample (Table D-7a).

Table 3-20 Percentages of Indicator-concepts Related to each SFM-associated Element of the Conservation of Soil and Water Resources Criterion

Observations	Criterion # 3: Conservation of Soil and Water Resources	
	Physical & environmental factors element (%)	Policy & protection factors element (%)
Model Forests		
A	80	20
B	78	22
C	71	29
D	44	56
E	75	25
Average Model Forests	70 ($\overline{n}$ =6)	30 ($\overline{n}$ =3)
Forest Companies		
1	63	37
2	71	29
3	38	63
4	80	20
5	79	21
6	75	25
7	80	20
Average Forest Companies	69 ($\overline{n}$ =16)	31 ($\overline{n}$ =6)
Average Total	69 ($\overline{n}$ =12)	31 ($\overline{n}$ =5)

Large proportions of indicator-concepts are associated with the elements of 'physical and environmental factors,' compared to the 'policy and protection factors.' The Mann-Whitney test showed that these percentages are statistically different ($p<0.05$) for these elements within groups. Moreover, the data shows that the Model Forests and forest companies have a similar percentage of indicator-concepts associated with 'policy and protection,' and 'physical and environmental' elements (Table D-7b). The Mann-Whitney tests also show that these elements are similarly addressed ($p> 0.05$) by the Model Forests and forest companies (Table D-7c).

The distribution of these elements by Model Forests and forest companies is shown in Figure 3-10:

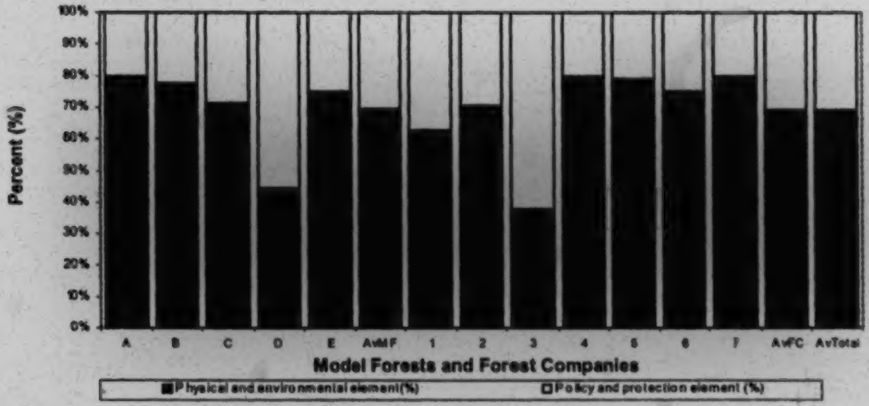

Figure 3-10 Percentage Distribution of the Conservation of Soil and Water Resources SFM-associated Elements in the Model Forests and Forest Companies

Criterion #4 Forest Ecosystem Contribution to Global Ecological Cycles

Table 3-21 shows the percentages of indicator-concepts associated to the elements under this criterion. The proportions do not show a high variation within the groups. Chi-square tests demonstrated no significant differences ($p>0.05$) for these elements within the groups or the pooled sample (Table D-8a).

Table 3-21 Percentages of Indicator-concepts Related to each SFM-associated Element of the Forest Ecosystem Contribution to Global Ecological Cycles Criterion

	Criterion # 4: Forest Ecosystem Contribution to Global Ecological Cycles				
Observation	**Contributions global carbon element (%)**	**Forest land conversion element (%)**	**Forest sector carbon dioxide element (%)**	**Forest sector policy factors element (%)**	**Contributions to hydro cycles element (%)**
Model Forests					
A	46	18	9	9	18
B	38	13	12	12	25
C	38	15	8	8	31
D	50	10	10	10	20
E	33	17	17	17	16
Average Model Forests	**41 ($\bar{n}$ =4)**	**15 ($\bar{n}$ =1)**	**11 ($\bar{n}$ =1)**	**11 ($\bar{n}$ =1)**	**22 ($\bar{n}$ =2)**
Forest Companies					
1	72	6	5	6	11
2	50	13	6	6	25
3	55	9	9	9	18
4	59	29	5	5	2
5	50	8	17	8	17
6	46	18	9	9	18
7	63	10	10	6	11
Average Forest Companies	**56 ($\bar{n}$ =11)**	**13 ($\bar{n}$ =3)**	**9 ($\bar{n}$ =1)**	**7 ($\bar{n}$ =1)**	**15 ($\bar{n}$ =2)**
Average Total	**50 ($\bar{n}$ =8)**	**14 ($\bar{n}$ =2)**	**10 ($\bar{n}$ =1)**	**9 ($\bar{n}$ =1)**	**18 ($\bar{n}$ =2)**

A large proportion of indicator-concepts are associated with 'contributions to global carbon stock,' compared to the remaining elements. The Kruskal–Wallis tests of significance established that these elements are different ($p<0.05$) within groups (Table D-8b). In addition, Dunn's test determined which elements differed significantly from each other under this criterion. Table 3-22 shows the outcomes for this test.

Table 3-22 Dunn's Test Outcome for Forest Ecosystem Contribution to Global Ecological Cycles SFM-associated Elements

	Model Forests				Forest Companies				Pooled Data			
Element	**CGC**	**FLC**	**FCD**	**FP**	**CGC**	**FLC**	**FCD**	**FP**	**CGC**	**FLC**	**FCD**	**FP**
CGC	N/A				N/A				N/A			
FLC	---	N/A			*	N/A			**	N/A		
FCD	**	---	N/A		**	---	N/A		**	---	N/A	
FP	**	---	---	N/A	**	---	---	N/A	**	---	---	N/A
CHC	---	---	---	---	---	---	---	---	*	---	---	**

CGC=Contributions global carbon, FLC=Forest land conversion, FCD=Forest sector carbon dioxide, FP=Forest sector policy factors= CHC=Contributions to hydro cycles element

Results from Dunn's test showed that, at a 5% level of significance, 'contributions to global carbon budget' is significantly different then 'forest sector carbon dioxide' and 'forest sector policy factors' in all groups. Also, at a 5% level of significance 'contributions to global carbon budget' is significantly different then 'forest land conversion' in the pooled data. This situation is seen in the forest companies at a 10% level of significance. Moreover, in the pooled data, at a 5% level of significance, 'contribution to hydrological cycles' is significantly different then 'forest sector policy factors,' and at a 10% level of significance, 'contributions to global carbon budget' is significantly different then 'contribution to hydrological cycles' element.

The data also showed that Model Forests have slightly higher percentages of indicator-concepts associated with the elements of 'forest land conversion,' 'forest sector carbon dioxide,' 'forest sector policy factors,' and 'contribution to hydrological cycles,' compared to the forest companies. Correspondingly, forest companies have a higher percentage of indicator-concepts associated with the 'contributions to global carbon' element, compared to the Model Forests. A Mann-Whitney U test showed that, at a 5% level of significance, 'contributions to global carbon budget' and 'forest sector policy factors' are significantly different between Model Forests and the forest companies. In addition, at a 10% level of significance, the 'contributions to hydrological cycles' element is different between Model Forests and the forest companies (Table D-8c).

The distribution of elements for the criterion, 'forest ecosystem contribution to global ecological cycles' by Model Forests and forest companies is shown in Figure 3-11:

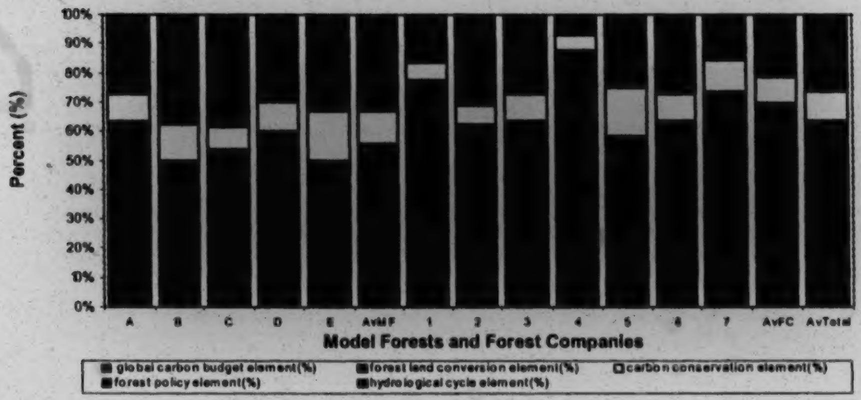

Figure 3-11 Percentage Distribution of Forest Ecosystem Contribution to Global Ecological Cycles SFM-associated Elements among Model Forests and Forest Companies

Criterion #5 Multiple Benefits to Society

Table 3-23 presents proportions of indicator-concepts related to the elements under this criterion. The variation of proportions is relatively low within each group. Chi-square tests demonstrate no significant differences ($p>0.05$) for these elements within either the groups or the pooled sample (Table D-9a).

Table 3-23 Percentages of Indicator-concepts Related to each SFM-associated Element of the Multiple Benefits to Society Criterion

Observation	**Criterion # 5: Multiple Benefits to Society**			
	Productive capacity element (%)	**Competitiveness of resource industries element (%)**	**Contribution to national economy element (%)**	**Non-timber values element (%)**
Model Forests				
A	54	10	12	24
B	56	11	11	22
C	54	12	4	31
D	64	9	9	18
E	69	3	3	25
Average Model Forests	**59 ($\overline{n}$ =16)**	**9 ($\overline{n}$ =2)**	**8 ($\overline{n}$ =2)**	**24 ($\overline{n}$ =7)**
Forest Companies				
1	65	2	9	23
2	73	5	7	16
3	59	8	10	23
4	63	8	12	17
5	55	9	9	27
6	47	7	20	27
7	66	3	3	28
Average Model Forests	**61 ($\overline{n}$ =23)**	**6 ($\overline{n}$ =2)**	**10 ($\overline{n}$ =3)**	**23 ($\overline{n}$ =7)**
Average Total	**60 ($\overline{n}$ =20)**	**7 ($\overline{n}$ =2)**	**9 ($\overline{n}$ =3)**	**23 ($\overline{n}$ =7)**

In addition, a high proportion of indicator-concepts is associated with the 'productive capacity' element, compared to the remaining elements. The Kruskal–Wallis tests of significance established that these elements are different ($p<0.05$) within groups (Table D-9b). In addition, Dunn's test showed which elements differed significantly from each other under this criterion. Table 3-24 shows the outcomes for this test.

Table 3-24 Dunn's Test Outcomes for the SFM-associated Elements of the Criterion Multiple Benefits to Society

	Model Forests			Forest Companies			Pooled Data		
Element	**PC**	**CRI**	**CNE**	**PC**	**CRI**	**CNE**	**PC**	**CRI**	**CNE**
PC	N/A			N/A			N/A		
CRI	**	N/A		**	N/A		**	N/A	
CNE	**	---	N/A	**	—	N/A	**	---	N/A
NTV	---	---	---	—	*	---	—	**	**

PC= Productive capacity, CRI= Competitiveness of resource industries, CNE= Contribution to national economy, NTV= Non-timber values

The results of Dunn's test explain that at a 5% level of significance, 'contributions to productive capacity' is significantly different then elements 'competitiveness of resource industries' and 'contribution to the national economy' in all groups. Similarly, at a 5% level of significance, 'non-timber values' is significantly different then 'competitiveness of resource industries' in the pooled data. This situation is seen in the forest companies at a 10% level of significance. Finally, in the pooled data, at a 5% level of significance, 'non-timber values' is significantly different then 'contribution to the national economy' element.

The data also shows that Model Forests are likely to have a slightly higher proportion of the elements: 'competitiveness of resource industries' and 'non-timber values,' compared to the forest companies. In contrast, the forest companies have a higher percentage of the 'productive capacity' and 'contribution to national economy' elements, compared to the Model Forests. A Mann-Whitney U test estimated that the 'competitiveness of resource industries' element is differently applied between Model Forests and forest companies (Table D-9c).

The distribution of these elements in the Model Forests and the forest companies is shown in Figure 3-12:

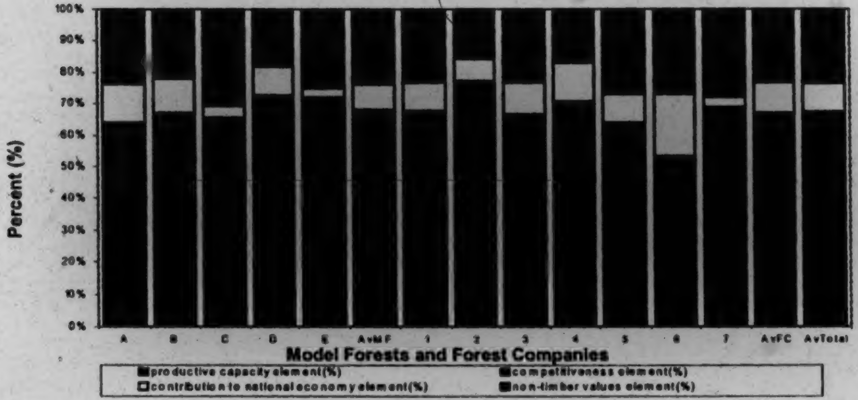

Figure 3-12 Percentage Distribution of Multiple Benefits to Society SFM-associated Elements among Model Forests and Forest Companies

Criterion #6 Accepting Society's Responsibility for Sustainable Development

Table 3-25 shows the proportions of indicator-concepts associated with elements under this criterion. In the table, a variation of proportions is seen within each group, though the Chi-square test shows no significant differences (p>0.05) for these elements within either a group or the pooled sample (Table D-10a).

Table 3-25 Percentages of Indicator-concepts Related to each SFM-associated Element of the Accepting Society's Responsibility for Sustainable Development Criterion

Observation	Criterion # 6: Accepting Society's Responsibility for Sustainable Development				
	Contributions Aboriginal and Treaty Rights element (%)	Participation Aborig. Comm. in SFM element (%)	Sustainability of Forest Comm. element (%)	Fair / Effective Deci-Making element (%)	Informed Deci-Making element (%)
Model Forests					
A	5	10	21	11	53
B	23	6	6	6	59
C	10	20	30	10	30
D	12	25	12	12	38
E	11	22	11	22	33
Average Model Forests	**12 ($\overline{n}$ =2)**	**17 ($\overline{n}$ =2)**	**16 ($\overline{n}$ =2)**	**12 ($\overline{n}$ =1)**	**42 ($\overline{n}$ =6)**
Forest Companies					
1	18	32	5	29	16
2	21	43	4	18	14
3	13	33	7	20	27
4	13	33	7	20	27
5	31	23	15	15	15
6	9	46	8	8	31
7	15	38	8	15	23
Average Forest Companies	**17 ($\overline{n}$ =4)**	**36 ($\overline{n}$ =9)**	**8 ($\overline{n}$ =1)**	**18 ($\overline{n}$ =5)**	**22 ($\overline{n}$ =4)**
Average Total	**15 ($\overline{n}$ =3)**	**28 ($\overline{n}$ =6)**	**11 ($\overline{n}$ =2)**	**16 ($\overline{n}$ =3)**	**30 ($\overline{n}$ =5)**

Furthermore, a great proportion of indicator-concepts was associated with the 'informed decision-making' element, in contrast to the remaining elements. The Kruskal–Wallis tests established that these elements are different ($p<0.05$) within groups (Table D-10b). Moreover, Dunn's test determined which elements differed significantly from each other under this criterion. (Table 3-26).

Table 3-26 Dunn's Test Outcome for Forest Ecosystem Contribution to Global Ecological Cycles SFM-associated Elements

	Model Forests				Forest Companies				Pooled Data			
Element	**CAR**	**PA**	**SFC**	**FDM**	**CAR**	**PA**	**SFC**	**FDM**	**CAR**	**PA**	**SFC**	**FDM**
CAR	N/A				N/A				N/A			
PA	—	N/A			**	N/A			—	N/A		
SFC	—	—	N/A		—	**	N/A		—	**	N/A	
FDM	—	—	—	N/A	—	*	—	N/A	—	—	—	N/A
IDM	**	—	—	**	—	—	*	—	*	—	**	*

CAR= Contributions Aboriginal and Treaty Rights PA= Participation Aboriginal Communities
SFC= Sustainability of Forest Communities FDM= Fair and Effective Decision Making
IDM= Informed Decision Making

Results from Dunn's test indicate that, at a 5% level of significance, 'informed decision-making' is significantly different then 'contributions to the aboriginal and treaty rights' and 'fair and effective decision-making' elements in the Model Forests. Moreover, in the forest companies, at a 5% level of significance, 'participation by aboriginal communities' is significantly different then 'contributions to the aboriginal and treaty rights' and 'sustainability of forest communities.' In the same group, at a 10% level of significance, 'participation by aboriginal communities' is significantly different then 'fair and effective decision-making' element, and 'informed decision-making' is significantly different then 'sustainability of forest communities' element. As well, in the pooled data, at a 5% level of significance, 'participation by aboriginal communities' is significantly different then 'sustainability of forest communities,' and 'informed decision-making' is significantly different then 'sustainability of forest communities.' Nevertheless, in the same group, at a 10% level of significance, 'informed decision-making' is significantly different then 'contributions to the aboriginal and treaty rights' and 'fair and effective decision-making' elements.

The data illustrates that Model Forests have higher proportions of indicator-concepts associated with the elements of 'sustainability of forest communities,' and 'informed decision-making,' compared to forest companies. Correspondingly, forest companies have a higher percentage of indicator-concepts associated with the 'contributions to the aboriginal and treaty rights,' 'participation by aboriginal communities,' and 'fair and effective decision-making' elements, compared to the Model Forests. A Mann-Whitney U test showed that, at a 5% level of significance, the elements, 'participation by aboriginal communities in sustainable forest management' and 'informed decision-making' were significantly different between Model Forests and the forest companies. In addition, at a 10 % level of significance, the 'sustainability of forest communities' element is significantly different between the two groups (Table D-10c).

The distribution of these elements in the Model Forests and forest companies is shown in Figure 3-13:

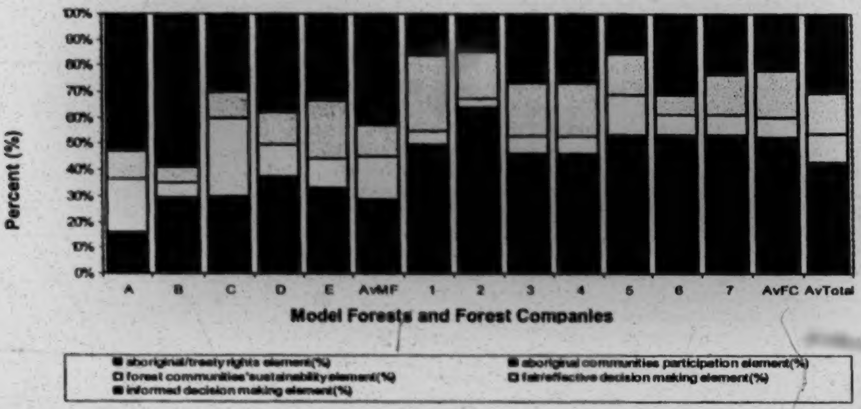

Figure 3-13 Percentage Distribution of the Accepting Society's Responsibility for Sustainable Development SFM-associated Elements among Model Forests and Forest Companies

3.7 Discussion

In the statistical analysis, the results were arranged in three categories: consistency, rankings of elements and criteria, and dominance. First, consistency (within groups) was assessed, where the degree of coherence in applying a variable similarly within groups was estimated. In this case, the analysis of consistency showed whether a given SFM-associated element or criterion was used similarly within Model Forests and forest companies. Second, rankings of elements and criteria assessed the relative importance of a particular SFM-associated element and criterion within Model Forests and forest companies. Third, dominance (between groups) attempted to measure (at a given point in time) whether a given SFM-associated element or criteria was more prevalent for Model Forests versus forest companies.

The examination of consistency showed that no statistically significant differences were present in the application of SFM-associated elements within groups. However, statistically significant differences were found in the application of some CCFM criteria. Specifically, the criteria 'conservation of soil and water resources' along with 'accepting society's responsibility for sustainable development' criteria were not applied in similar ways among forest companies. Moreover, the criterion 'multiple benefits to society' was applied differently among forest companies and among Model Forests. It is interesting to note that the CCFM C&I set used in this study has been subsequently changed, such that the "multiple benefits to society" criterion no longer exists. In the new CCFM C&I set, this criterion was redesigned as "Economic and Social Benefits"; thus, this criterion was simplified from "multiple benefits" to "economic and social benefits." Perhaps the lack of consistency reflects a lack of clarity in the original criterion that was subsequently eliminated.

From the analysis of rankings of elements and criteria, the results show hierarchical positions for SFM-associated elements or criteria within Model Forests and forest companies. Table 3-27 shows the rankings by group. These rankings are arranged in order of percentages, and different rankings do not represent statistically significant differences. The tied numbers represent equal percentages between elements.

Table 3-27 Ranking of Sub-categories in SFM-associated Elements and Criteria within Model Forests and Forest Companies

Criteria and SFM-associated elements	Ranking of subcategories in Model Forests	Ranking of subcategories in Forest Companies
Equity		
Inter-generational	1	1
Intra-generational	2	2
Sustainability		
Economic	1	1
Social	3	3
Environmental	2	2
Level		
Community	1	1
Regional-Provincial	2	2
Criterion 1 Biological diversity	2	4
Ecosystem diversity	1	1
Species diversity	2	2
Genetic diversity	3	3
Criterion 2 Forest ecosystem productivity	4	6
Incidence of disturbance and stress	2	2
Ecosystem resilience	1	1
Extent biomass	3	3
Criterion 3 Conservation of soil and water	6	3
Physical and environmental factors	1	1
Policy and protection forest factors	2	2
Criterion 4 Contribution to global ecological cycles	5	5
Contributions to global carbon cycles	1	1
Forest land conversion	3	3
Forest sector carbon dioxide conservation	4	4
Forest sector policy factors	4	5
Contributions to hydrological cycles	2	2
Criterion 5 Multiple benefits to society	1	1
Productive capacity	1	1
Competitiveness of resource industries	3	4
Contribution to the national economy	4	3
Non-timber values	2	2
Criterion 6 Accepting society's responsibility	3	2
Aboriginal and treaty rights	4	4
Participation by Aboriginal communities in SFM	2	1
Sustainability of forest communities	3	5
Fair and effective decision making	4	3
Informed decision making	1	2

From Table 3-27, the criterion 'multiple benefits to society', was ranked first in both groups, perhaps because the vagueness of the criteria caused a large number of concepts to count towards this criteria. In general, results showed a great deal of consistency between the rankings of both groups. It seems as though forest companies and Model Forests may be following an established set of guidelines in developing their C&Is.

The only discrepancy in rankings between the two groups was for the criterion 'accepting society's responsibility for sustainable development.' For this criterion, the 'informed decision-making' element was ranked first in the Model Forests, whereas the 'participation by aboriginal communities' element was ranked first in forest companies. It is not unreasonable to postulate that working in a multiple partnership, and operating on public lands, 'informed decision making' becomes a priority for Model Forests. On the other hand, the outcome for forest companies might be due to a greater consideration of the already existing aboriginal and title rights in their forest management areas, as well as of other existing regulations that require companies to include aboriginal people in their forest management activities.

The analysis of dominance also shows that the importance of C&I are largely similar for forest companies and model forests. Of the 30 elements surveyed, 16 elements were not found to be used differentially by Model Forests and forest companies. This result could be due to a small sample size which could prevent us from detecting significant differences. Statistically significant differences were, however, found in the application of fourteen SFM-associated elements. Table 3-28 shows these SFM-associated elements and the groups in which they prevailed or were dominant.

Table 3-28 SFM Elements Differently Applied between Model Forests and Forest Companies

Criteria	Elements[a]	Dominant Group[b]
Equity	Inter-generational **	Forest companies
	Intra-generational **	Model Forests
Sustainability	Environmental **	Forest companies
Level	Community level **	Forest companies
	Regional-provincial level **	Model Forests
C2 'Maintenance and enhancement of forest ecosystem condition and productivity'	Ecosystem resilience *	Forest companies
	Extent of biomass *	Model Forests
C4 'Forest ecosystem contribution to global ecological cycles'	Contributions to global carbon **	Forest companies
	Forest sector carbon policy factors **	Model Forests
	Contribution to hydrological cycle *	Model Forests
C5 'Multiple benefits to society'	Competitiveness of resource industries **	Model Forests
C6 'Accepting society's responsibility for sustainable development'	Participation by aboriginal communities in SFM **	Forest companies
	Sustainability of forest communities *	Model Forests
	Informed decision-making **	Model Forests

[a] ** denotes 5% level of significance, and * 10% level of significance.

[b] 'Dominant group' refers to that group where the element was more commonly found.

In Model Forests, 8 elements are dominant, including not only those that are timber-oriented, but also include a wide range of socio-economic and environmental aspects. The presence of different stakeholders in Model Forests likely contributes to the wide range in the dominating SFM-associated elements. In forest companies, 6 elements are dominant and similarly cover a broad range of socio-economic and environmental values.

Chapter 4: Case Study on Forest Certification

4.1 Introduction

This chapter begins with background information about forest certification, and considers the potential role that corporate social responsibility may play within forest certification. Research questions and a-priori expectations are presented. The ensuing sections discuss data collection, content analysis, and the statistical methods used. Content analysis is used to assess the presence or absence of FSC principles in North American forest companies' certification reports. Finally, the results are presented and discussed.

4.2. Background on Forest Certification

4.2.1 Forest Certification and Corporate Social Responsibility

Since the 19th century, externalities in the forestry sector have remained a main concern for economists (Adamowicz, Boxall, Luckert, Phillips, White, 1996; Beaulieu and Gaisford, 2000; Papandreou 1994; Riera and Niskanen, 2003). Generally, three mechanisms are recognized to correct the externalities: command and control, norms, and market incentives (Portney and Stavins, 2000). Forest certification may be classified as an incentive that uses market forces to pursue sustainable forest management (Meidinger, Elliott and Oesten, 2003; Upton and Bass, 1995). Also, forest certification may be a means of dealing with problems caused by externalities, by promoting responsible industrial and sustainable forestry practices, not only to obtain market access and price premiums, but to procure a 'social license' (Eskow, 2001; Gunningham, Kagan, and Thornton, 2004). The pursuit of a social license is consistent with recognizing that corporate social responsibility can address the negative effects of the externalities (Menon and Menon, 1997).

Although forest certification is considered to be a market-driven tool, theoretically, market benefits are not always clear. In fact, the evidence suggests that premium prices for certified wood products are low and infrequent. Furthermore, the demand for certified wood products by end-users is low, and is not expected to increase in the near future (Siry, Cubbage and Rukunuddin, 2003). For example, in Germany, studies indicate a low demand for certified wood products by consumers, and that less than 2% of the population knows about the Pan-European Forest Certification system (PEFC) or the Forest Stewardship Council (FSC). In addition, certified wood products constitute less than 1% of the total forest trade in Germany (Teegelbekkers, 2003).

According to research findings, a main driving force behind forest certification does not appear to be the consumers, but the non-governmental organizations and retailers. Some researchers theorize that non-governmental organizations promote forest certification as a means to diminish deforestation and clear-cutting in old growth forests, and to improve biodiversity conservation (Rametsteiner and Simula, 2003). In addition, some retailers promote forest certification to implement a philosophy of corporate social responsibility throughout their company, and to support activities leading to enhanced environmental sustainability and conservation (B&Q, 2005; Bills, 2003; Business for Social Responsibility, 2005; Home Depot, 2005). Consequently, non-governmental organizations and retailers may benefit by promoting an environmental image. Thus, forest certification could be seen as an answer to society's growing demand for corporate social responsibility (Richards, 2004; van Kooten, Nelson and Vertinsky, 2004).

Since 1960, corporate social responsibility has been an issue of interest to economists and private companies (Davis, 1960). Corporate social responsibility is commonly defined as 'the promotion of sustainable development; thus, economic, environmental and social concerns are main aspects of corporate social responsibility (Cramer, 2005). Involving economic, environmental, and social issues into business operations is well-described by Dalla Costa (1998) and Hawken (1993). The authors recognize that enhancing the long-term value of a company requires its managers and employees to run the business in a profitable way, and in a socially-, environmentally-, and economically-responsible manner.

Traditionally, economists did not always consider private altruistic activities (Johnson, 1966) and sometimes classify such behaviour as 'economically irrational' (Schwartz, 1968). Even though classified as irrational, corporations may be motivated by either philanthropy or social responsibility because business philanthropy may be seen as 'driven by the hope of increased revenue' (Burt, 1983; Johnson, 1966).

Firms may use corporate contributions as a kind of capital investment (Webb, 1996). For instance, contributions to 'good cause' organizations can promote a better image of the company with their current and potential customers, as well as with their own employees (Navarro, 1988). Thus, customers would be more prone to purchase the firm's products, and the firm's demand curve for the product would shift in a positive way (Schwartz, 1968). Also, employees would be more disposed to work for the corporation if firms support local community activities, and have a better work environment (Navarro, 1988). In this sense, corporate altruism may be seen as a capital investment as it benefits the company in the long-run.

4.2.2 Forest Values

The main objective of forest certification is to guarantee to society that balance of economic, social, and environmental values are retained in the world's forests, and that these values are enhanced through sustainable forest management (Fern, 2001). Forest values include not only use values, but also non-use values such as social, spiritual, and cultural aspects (Kant and Lee, 2004). The social values associated with forests may differ among countries depending on their history, cultural, and political approaches. In particular, values arise from particular human perceptions, and are related to current or possible future changes of forest states. Consequently, society would be seen as not valuing the forest itself, but as valuing one forest condition instead of another (Gregersen, Lundgren, Kengen and Byron, 1997).

Forest certification aims to protect forest values such as biodiversity and non-timber benefits, and to address aboriginal and other social demands (Fern, 2001). To support the public involvement in identifying forest values relevant for their social, ecological, and economic concerns and needs, the FSC promote the development of regional and national standards using the FSC principles framework (FSC, 2004g).

Despite the potential importance of forest certification, there has been very little inquiry into what countries use which system, and why. Thornber (1999) analyzed 156 FSC certificates around the world, and found that geographical influences are in the FSC principles applied to certified forest companies. In fact, Thornber's report described certifiers using either non-identical standards or local standards to respond to national forest characteristics and social demands. Nevertheless, Thornber (1999) did not explain why geographical differences exist, and whether or not these differences are related to social values or demands.

In this study, we assessed whether differences exist between Canada and the US, with regards to principles used by FSC-certified forest companies. If differences exist, then dissimilar forest values and/or dissimilar corporate social responsibility approaches might also exist between the two countries.

4.3 Research Question

The general purpose of this study was to assess whether or not differences in the application of FSC principles varied between Canada and the US. Specifically, the following research question was explored:

> Are FSC principles applied in significantly different ways among the forest companies of Canada and the US?

4.4 *A Priori* Expectations

Values associated with forests may differ among countries depending on their history, cultural, political, and ownership approaches (Gregersen *et al,* 1997). These values influence and are influenced by the social, historical, cultural, economic, and institutional framework where a group of people or society lives (Shultz and Zelezny, 1999). The FSC principles may represent different forest characteristics that society values and may want to maintain in their forests. Thus, the FSC forest principles could be considered as proxies for forest values in countries like Canada and the US.

Canada and the US tend to be similar in their forest management strategies, silvicultural techniques, worker relationships, applied technology, and scientific research

(Shindler, Beckley and Finley, 2003). Given these similarities, forest companies in both countries would not be expected to be significantly different in their approaches to FSC principles in areas of worker's rights, and management plan adoption. Thus, forest values related to these FSC principles may not be highly dissimilar in the two countries. However, two main differences exist between these two countries: forest ownership, and approaches to aboriginal issues (Shindler *et al*, 2003).

On the subject of forest ownership, 94% of Canada's forests are publicly-owned (Canadian Forest Service, 2003), compared to 27% under public tenure in the US (Shindler *et al*, 2003). Private values associated with private ownership could be less broad than public values under public ownership, as public forest resources are likely to be more exposed to social demands (Shindler *et al*, 2003). Moreover, enforcement on private lands is sometimes less stringent and, to some extent, self-regulatory. In this regard, Cashore and McDermott (2004) reported that Canada and the US exhibit differences in terms of forest policy applications, and the authors also showed that Canada has more rigorous forest regulations and policies for protecting forest values other than wood. Therefore, ownership differences between both countries may influence the use of FSC principles in connection with tenure and use rights; benefits from the forest; application of environmental measures; use of monitoring and assessment techniques; and conservation of high value forests.

With regards to aboriginal issues, Canada and the US have different approaches to the rights of indigenous peoples. According to Kant and Zhang (2002), the co-management regimes that exist in Canadian forests among aboriginal people, and provincial and private firms are due to a high importance placed on aboriginal rights and values. In addition, forest companies in Canada allocate resources, professionals, and experts to work jointly with aboriginal groups, governmental bodies, forest communities, researchers, and environmental groups (Weaver, 2003). Because nearly 80% of Canada's aboriginal groups live in forest areas, forest companies are involving these groups in their forest management and related activities (Weaver, 2003). For example, the Canadian forest industry employs, trains, and awards contracts to aboriginal people (Canadian Forest Service, 2003). In addition to the forest private sector, the Canadian government has incorporated the notion of forest management for cultural, spiritual, and economic values in its National Forest Strategy (Canadian Forest Service, 2003). In fact, Canada is committed to enhancing the role of aboriginal groups in the economic development of forest resources at national and international levels (Stevenson and Webb, 2003). In addition, in Canada, a link exists between Crown land administered by the provincial governments and the rights of First Nations in accessing natural resources, which is in contrast to the situation in the US (Shindler *et al*, 2003).

Different attitudes towards aboriginal people that exist in the two countries may stem from the Royal Proclamation of 1763[11] Although signed by Canada and the US, this proclamation has evolved differently in these countries. In Canada, this instrument is not a constitutional document though it is recognized in the Canadian Charter of Rights and Freedoms, and in many court decisions (Stevenson and Webb, 2003).

In contrast, in the US, this proclamation was the principal reason for the break with the British Empire that gave rise to US independence (Cave, 2003). In addition, in 1830 the 21st Congress of the US approved the Indian Removal Act. According to Cave

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[11] Personal conversation with Dr. Hickey, an Anthropologist Professor Emeritus at the University of Alberta, and a Research Area Leader for *Sustainable Aboriginal Communities* in the Sustainable Forest Management Network. May, 2005

(2003), land greed and a mentality of Indian hating were the main reasons for the approval of the Indian removal.

In summary, the rights of aboriginal people seem to have a higher priority in Canada than in the US.

Taken together, and based on differences in land ownership and aboriginal issues in Canada and the US, the application of FSC principles may be emphasized differently in the two countries. Thus, in Canada, forest companies are hypothesized to pursue FSC forest certification with a greater emphasis on aboriginal rights, and may place more significance on non-timber benefits, relations with communities, and monitoring and assessment procedures, with application of environmental impact measures, and maintenance of high conservation value forests. In the US, in contrast, the opposite situation would be expected for the forest companies in pursuing FSC forest certification.

4.5 Data Collection and Content Analysis

As of December 2003, 17 FSC certified forests were located in Canada and 100 were in the US (FSC, 2004e). Generally, all reports are public, though not all are available on the Internet. The data in this study is from 111 FSC public reports (16 in Canada and 95 in the US) that were available and retrieved from the Internet from August 2003 to January 2004. Together, these companies have 3.35 million certified hectares in Canada and 3.51 million certified hectares in the US.

Canadian forest companies that were assessed in this study are located in different provinces, implementing forest activities on public and private lands. These certified forests are mainly located in Ontario (96%), and are largely operating in public lands (97%). Table 4-1 shows their location, ownership, and certified areas.

Table 4- 1 Distribution, Ownership, and Area of FSC Canadian Forest Companies

Province	Land Ownership	Number of Certified Forests	Area (ha)
British Columbia	Private	0	0
	Public	5	100,291
New Brunswick	Private	2	984
	Public	0	0
Nova Scotia	Communal	1	384
Ontario	Private	3	58,025
	Public	4	3,169,197
Quebec	Private	1	27,064
	Public	0	0
Total by ownership	Private	6	86,073
	Public	9	3,269,488
	Communal	1	384
TOTAL		16	3,355,945

The US forest companies assessed in this study are distributed in different states, carrying out forest activities on private (52%) and public (46%) lands. Certified forest firms operating on public lands are generally public organizations, and mainly associated with counties, cities, universities, or other types of non-profit organizations. These organizations do not operate on US Forest Service lands. The certified forests are mainly located in Pennsylvania (27.4%), and Maine (17.5%). Table 4-2 shows their location, ownership, and certified areas.

The FSC reports of firms in Tables 4-1 and 4-2 were examined (the reports are listed in Appendix E). A content analysis was conducted for each FSC report. In this case study, the objective of the content analysis was to screen through each FSC report, and to examine the content and identify concepts linked with principles used to obtain FSC certification in Canada and the US.

A codebook and the coding form used to organize FSC principles are presented in Appendix F. This framework is based on the FSC Principles and Criteria for Forest Stewardship (FSC, 2004b).

Table 4- 2 Distribution, Ownership, and Area of FSC US Forest Companies

Province	Land Ownership	Number of Certified Forests	Area (ha)
California	Private	25	461,629
	Public	1	720
	Communal	1	34,836
Connecticut	Private	1	3,173
	Public	0	0
Louisiana	Private	1	195,135
	Public	0	0
Maine	Private	4	412,944
	Public	2	208,241
Massachusetts	Private	2	11,697
	Public	0	0
Michigan	Private	1	63,272
	Public	0	0
Minneapolis	Private	1	1,681
	Public	0	0
Minnesota	Private	2	1,642
	Public	3	345,866
Missouri	Private	1	64,342
	Public	0	0
Mississippi	Private	1	132,159
	Public	0	0
New Hampshire	Private	3	17,729
	Public	0	0
New York	Private	5	51,053
	Public	1	290,275
North Carolina	Private	2	5,018
	Public	0	0
Ohio	Private	1	4,164
	Public	0	0
Oregon	Private	13	55,142
	Public	1	1,498
Pennsylvania	Private	4	72,420
	Public	1	898,835
South Carolina	Private	2	8,669
	Public	0	0
Tennessee	Private	0	0
	Public	1	64,227
Vermont	Private	5	36,778
	Public	0	0
Washington	Private	3	16,346
	Public	1	35,005
West Virginia	Private	1	3,985
	Public	0	0
Wisconsin	Private	3	9,903
	Public	0	0
	Communal	1	6,313
TOTAL BY OWNERSHIP	Private	81	1,628,881
	Public	12	1,844,667
	Communal	2	41,149
TOTAL		95	3,514,697

Each FSC report was analyzed according to the codebook. A concept associated with each FSC principle was counted once per certified forest, so that the content analysis investigated the existence (presence/absence of a given concept associated to a FSC principle) not the frequency.

To achieve reliability, each report was coded twice. Reliability refers to the act of uniformly re-coding equal text in the same way over a time interval. In this case, intra-rater reliability, also known as stability, was assessed and calculated by the coefficient of agreement (Milne and Adler, 1998). In total, 4,551 (111 reports x 41 concepts) components were classified. In the second coding, 4,484 components were matched with the first coding. Thus, the coefficient of agreement was calculated to be 98%. The content analysis method is discussed in detail in Chapter 3.

4.6 Statistical Methods

In this section, two statistical methods are introduced to address the research question, namely: a binomial logit and a loglinear model (i.e., the logistic regression procedure). By using the different methods, the findings can be compared and a greater confidence in the statistical results is possible.

4.6.1 Binomial Logit Model

A binomial logit model was used to investigate the association between each FSC principle (dependent variables) with Canada and the US (independent variable). Binomial logit models assume that causality may exist. In this case, the hypothesis is that 'country' may cause forest companies to behave differently. Thus, 'country' may influence the likelihood of the application of each FSC principle. By using this model, differences in each FSC principle associated with each country, can be tested individually. Logit models are statistical procedures that can be used when the dependent variable is a choice variable rather than a continuous variable (Cramer, 2003). The binomial logit model is a binary discrete probability model that associates a binomial outcome or dichotomous dependent variable with one or more explanatory variables (Hosmer and Lemeshow, 2000).

In modelling a binary dependent variable, Y (in this case, the presence or absence of each FSC principle), and assuming that the error term is logistically distributed, the binomial logit model is written as:

$$P(Y=1)=\frac{e^{\beta' X}}{1+e^{\beta' X}}=\lambda(\beta' X)$$

Where X is a vector of independent variables (in this case, a binary variable representing Canada or the US); β is the vector of regression coefficients; and λ indicates the relationship between the probability and independent variables (Greene, 2000).

The logit model is based on the cumulative logistic probability function, which predicts the probability of an event, given particular conditions (Pindyck and Rubinfeld, 1981). Thus, the binomial logit model is commonly estimated by the method of maximum likelihood (Borooah, 2002). Since the logit model is estimated by maximum likelihood, the usual goodness of fit for linear regressions (R-squared) cannot be applied (Greene, 2000). Instead of R-squared, a different set of statistics was developed to assess goodness of fit based on chi-square and log-likelihood statistics (Cramer, 2003). McFadden (1974) and Estrella (1998) developed statistics for goodness-of-fit measures in discrete choice models, which express the explanatory power of the logit regression.

In addition, a likelihood ratio test is a common procedure to assess the overall performance in logit regressions (De Maris 1992; Greene, 2000; Liao, 1994). This procedure, which tests the null hypothesis that all coefficients (except the constant) are zero, takes the following form (Cramer, 2003):

$$LR = -2\left(\ln L\hat{r} - \ln \hat{L}\right)$$

In this case, $L\hat{r}$ are the log-likelihood functions assessed at the restricted, and $\hat{L}$ are the log-likelihood functions assessed at the unrestricted estimates.

4.6.2 Loglinear Models

The binomial logit model, introduced above, assumes causality, and therefore, considers that a country and the FSC principles have a relationship. This assumption of causality limits the possibility of testing a model where countries may not have an impact on the application of FSC principles. Loglinear models are used for assessing the strength of relationship without assuming causality (Tansey, Rebecca and Smith, 1996). Thus, to simultaneously assess these multiple FSC principles without considering an *a priori* relationship among the variables, a loglinear model was used. This model can identify the relationship among the FSC principles (set of predictors), and the differences in their implementation between Canadian and US forest companies (response variable). Loglinear modelling is a discrete multivariate statistical tool, designed to analyze data when both dependent and independent variables are categorical or nominal (Tansey *et al.*, 1996). Loglinear models are applicable when the study is focused on predicting which predictor variables differentiate the groups. Thus, for this study, loglinear modelling considers the influence of FSC principles as a group, and assists us in understanding the relationship or interaction among FSC principles and each country, without assuming any causality.

In this research, a particular case or subgroup of loglinear modelling (i.e., logistic regression) was used. For ordinal and nominal variables, either loglinear modelling or logistic regression can be applied (Tansey *et al.*, 1996). The logistic regression, however, has comparative advantages over loglinear modelling, since it can give a likelihood ratio test and the Wald Z statistics to assess the sign, standard error, and magnitude of the impact of each independent variable (covariate) on dependent variables (outcome variables) (Tansey *et al.*, 1996). In addition, Agresti (2004) recognizes that logistic regression models with qualitative predictors are analogous to particular loglinear models, having the same estimates and goodness-of-fit statistics. Finally, loglinear modelling may be useful when researchers need to develop models and add more variables to it (as interactions) to test all possible relationships (Streiner and Lin, 1998).

Logistic regression discriminates between a response variable (Y) and a set of predictors (x_n). In addition, predictor variables can be either quantitative or qualitative, which, in turn, can be expressed as dummy variables (Agresti, 1990).

If p is the probability of a certified forest company being in Canada, and $(1-p)$ is the probability of a certified forest company being in the US, and x_i is the set of FSC principles, then the logistic regression model is (Agresti, 2004):

$$\log\left(\frac{p}{1-p}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots.\beta_n X_n$$

The ratio p/(1-p) is identified as "odds," and its natural logarithm is "logit". The odds ratio is a way of identifying whether or not the probability of a forest company being in Canada is the same for two groups.

In this case, the null hypothesis is that no difference exists among predictors of different groups.

$H_{O:} : X_1 = X_2 = ...X_n$

The alternative hypothesis is that a statistically significant difference exists among predictors of different groups.

$H_A : X_1 \neq X_2 \neq ....X_n$

Two statistics (Cox and Snell's r-Square, and Nagelkerke's R-square) were used to assess the strength of any association among the variables within the model. In addition, to assess whether or not the data corresponds to the specified model, Hosmer and Lemeshow's goodness-of-fit test was used. In the same way, to assess the significance of individual logistic regression coefficients for each independent variable, the Wald statistics and the significances (p-values) were used (Hair, 1984; Hosmer and Lemeshow, 2000).

4.7 Variables Hypothesized Signs

As described in Chapter 2, 10 FSC principles are involved, which apply to all tropical, temperate, and boreal forests. The variables used in this study refer to FSC principles 1 to 9, since principle 10 is related to forest plantations, which is largely inapplicable to Canada and only partially applicable to the US.

As mentioned in Section 4.4, the main differences between Canada and the US are in the types of ownership (institutional) and in aboriginal (historical) issues. These differences could promote divergent social values in both countries, which could then affect the emphasis on FSC principles in certified forests.

Differences in the public values between both countries suggest that some FSC principles may be more highly present in Canada. Following the *a priori* expectations described in the previous section, FSC principles that are expected to have a higher positive correlation with Canada are ‘Community relations,’ ‘aboriginal rights,’ ‘forest benefits,’ ‘monitoring and assessment,’ ‘environmental impact assessment,’ and ‘maintenance of high conservation value forests.’ These variables are shown to have expected positive sign in Table 4-3. For the remaining variables, there was no expectation regarding their sign.

Table 4- 1 Variables Regarding FSC Principles

Variable	Explanation	Significance for Certified Forest	Sign[1]
P1 Laws	Is a dummy variable representing whether or not the FSC certificates include Principle 1 *Compliance with laws and FSC principles.* (1=includes this principle)	This principle encourages that forest management must comply with all applicable country laws, international treaties and agreements to which the country is signatory, and all FSC Principles and Criteria.	Indeterminate (+ / -)
P2 Tenure	Is a dummy variable representing whether or not the FSC certificates include Principle 2 *Tenure and use rights and responsibilities.* (1=includes this principle)	This principle promotes that forest management must exist in a legally, established and documented long-term tenure and use rights to the forest land.	Indeterminate (+ / -)
P3 Indigenous rights	Is a dummy variable representing whether or not the FSC certificates include Principle 3 *Indigenous peoples' rights* (1=includes this principle)	This principle encourages that forest management must respect and recognizes the legal and traditional rights of indigenous peoples to hold, use and manage their lands, territories, and resources.	Positive (+)
P4 Community	Is a dummy variable representing whether or not the FSC certificates include Principle 4 *Community relations and worker's rights* (1=includes this principle)	This principle advocates that forest management procedures must provide or enhance social and economic welfare for forest workers and local communities in the long-term.	Positive (+)
P5 Benefits	Is a dummy variable representing whether or not the FSC certificates include Principle 5 *Benefits from the forest* (1=includes this principle)	This principle promotes that forest management must support the effective use of forest's multiple goods and services to guarantee economic viability and to secure environmental and social benefits.	Positive (+)
P6 Environmental Impact	Is a dummy variable representing whether or not the FSC certificates include Principle 6 *Environmental impact* (1=includes this principle)	This principle encourages that forest management must conserve the ecological functions through the conservation of biological diversity, water resources, soils, fragile ecosystems and landscapes.	Positive (+)
P7 Management Plan	Is a dummy variable representing whether or not the FSC certificates include Principle 7 *Management plan* (1=includes this principle)	This principle promotes that forest management must have a written, executed, and contemporary management plan according to scale and operations.	Indeterminate (+ / -)
P8 Monitoring & Assessment	Is a dummy variable representing whether or not the FSC certificates include Principle 8 *Monitoring and assessment* (1=includes this principle)	This principle encourages that forest management must monitor and assess forest's condition, sustained yield, chain of custody, and their social and environmental impacts among others.	Positive (+)
P9 Conservation	Is a dummy variable representing whether or not the FSC certificates include Principle 9 *Maintenance of high conservation value forests* (1=includes this principle)	This principle promotes that forest management must conserve high conservation value forests and the characteristics that determine such forests.	Positive (+)

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[1] The dependent variable is defined as Canada=1, US=0. Therefore, a positive sign hypothesize a positive correlation between the FSC principle and Canada.

4.8 Descriptive Statistics for the FSC Principles

The mean values and standard deviations of variables for pooled data, Canada, and the US are presented in Table 4-4.

Table 4- 4 Descriptive Statistics for FSC Principles by Pooled Data, Canada and the US

	Pooled data		Canada		USA	
Variable (n= 111)	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
P1 Laws	0.802	0.400	0.813	0.403	0.8	0.402
P2 Tenure	0.730	0.446	0.875	0.342	0.705	0.458
P3 Indigenous rights	0.450	0.500	0.750	0.447	0.4	0.493
P4 Community	0.523	0.502	0.687	0.479	0.495	0.503
P5 Benefits	0.261	0.441	0.750	0.447	0.179	0.385
P6 Environmental Impact	0.387	0.489	0.562	0.512	0.358	0.482
P7 Management Plan	0.829	0.378	1.000	0.000	0.789	0.410
P8 Monitoring & Assessment	0.486	0.502	0.625	0.500	0.463	0.501
P9 Conservation	0.532	0.501	0.688	0.479	0.537	0.501

Table 4-4 provides a summary of the proportions of forest organizations (in pooled data, Canada, and the US) that are applying these FSC principles in their forest certification. For both countries together, a high presence is seen for the principles: 'compliance with laws and FSC principles' (P1), 'tenure and use rights and responsibilities' (P2), and 'management plan' (P7) (80%, 73%, and 83%, respectively). Alternatively, the FSC principle with a lower presence is 'benefits from the forest' (P5) (26%).

For Canada, all of the FSC principles appear with a higher frequency compared with the US. The principle with the highest presence is 'management plan' (100%). In contrast, the principle with the lowest presence is 'environmental impact' (56%). Consequently, the proportion of forest organizations using every FSC principle is greater than 55%, but, because 'management plan' has a 100% presence in the Canadian sample, a problem is created for the statistical models employed in this study. This principle could not be tested simultaneously with the other principles, though we note its importance here.

For the US, the principle with the highest presence was 'compliance with laws and FSC principles' (80%), and the principle with the lowest presence was 'benefits from the forest' (18%). In general, in comparing the data for the US and Canada, significant differences were seen in the principles: 'benefit of forests,' 'indigenous rights,' 'environmental impact assessment,' 'management plan,' 'monitoring and assessment,' and 'community relations.' The results show that these FSC principles are highly present in Canadian forest companies compared to those in the US. With regards to the principle, 'benefit of forests,' in Canada, 75% of the FSC companies use this principle, which is compared to 18% in the US. Similarly, with the principle, 'indigenous rights,' in Canada, 75% of the FSC companies apply this principle, compared to 40% in the US. With 'environmental impact assessment,' in Canada, 56% of its FSC companies apply this principle, compared to 36% in the US. With 'management plan,' in Canada, 100 % of the FSC companies apply this principle, compared to 79% in the US; and with 'monitoring and assessment,' in Canada, 62% of the FSC companies apply this principle, compared to 46% in the US. Finally, with 'community relations,' in Canada, 69% of the FSC companies apply this principle, compared to 50% in the US. The following section looks more closely at these differences, and assesses whether there are statistical significant differences.

4.9 Results

The results for the binomial logit model and the logistic regression are presented below.

4.9.1 Results from the Binomial Logit Model

This statistical tool was used to analyze the relationship between each FSC forest principle and the countries. A binomial logit model was developed for each FSC principle except for the principle 'management plan' (P7). It is important to recall that a model with this dependent variable could not be tested as a result of its high presence in the Canadian sample (100%). Thus, even though a binomial logit model could not be applied, we highlight the significance of this principle. Outcomes for the regressions are presented in Table 4-5:

Table 4- 5 Binomial Logit Model Results

Dependent Variable	P-value (Country)	Coefficient (Country)	Estrella	McFadden	Likelihood ratio test	Probability (LR stat) p-value
P1 Laws	p=0.907	0.80	0.000	0.000	0.013	0.907
P2 Tenure	p=0.173	1.07	0.020	0.017	2.282	0.130
P3 Indigenous rights	p=0.014	1.50	0.060	0.045	6.919	0.008
P4 Community	p=0.160	0.80	0.018	0.013	2.091	0.148
P5 Benefits	p=0.000	2.62	0.180	0.158	20.255	0.000
P6 Environmental Impact	p=0.127	0.83	0.021	0.015	2.351	0.125
P8 Monitoring & Assessment	p=0.236	0.65	0.013	0.000	1.445	0.229
P9 Conservation	p=0.267	0.64	0.011	0.000	1.296	0.254

A-priori, it was anticipated that the application of FSC principles might be weighted differently in the two countries. In this regard, it was proposed that dependent variables with a positive sign should be 'indigenous rights' (P3), 'community relations' (P4), 'benefit of forests' (P5), 'environmental impact assessment' (P6), 'monitoring and assessment' (P8), and 'conservation' (P9). As shown in Table 4-5, all coefficients have positive signs. However, statistical significance of these results is variable. For the two variables for which there were no *a priori* expectations, Laws (P1) was insignificant while tenure (P2) was significant at the 13% level. The significance of tenure could be due to more emphasis placed on describing secure, long term rights in Canadian documentation due to private management occurring on public land. In the US, legal long term tenure on private lands is likely assumed, and therefore not explicitly stated. Two principles which had expected positive signs 'indigenous rights' (P3) and 'benefit of forests' (P5) were significant at the 1% level, while two more principles with expected positive signs, 'community relations' (P4), and 'environmental impact assessment' (P6) were significant at the 15% level. The last two principles with positive expected signs, 'monitoring and assessment' (P8), and 'conservation' (P9), were only significant at approximately the 25% level.

Measures of goodness-of-fit for logit models (or the Pseudo-R-square) are the Estrella or McFadden tests (likelihood ratio tests). In general, the Estrella and the McFadden statistics are low for all models indicating a modest explanatory power for each logit regression. This low explanatory power might be explained by the fact that each model considers only one right-hand-side variable for one left-hand-side variable. The regression with a best goodness-of-fit test results (Estrella= 0.18 and McFadden= 0.16) is the 'benefits from the. forests'(P5) which also has the most significant country coefficient.

4.9.2 Results from Logistic Regression

A logistic regression was also used to assess the strength of the relationship among FSC principles between Canada and the US. By using this regression analysis, the strength between a response variable and a set of predictors was estimated. For the same reason described above, the variable 'management plan' could not be tested along with the others dependent variables. The result of this regression is presented in Table 4-6:

Table 4- 6 Logistic Regression Results

Predictors Variable	P-value=	Coefficient
P1 Laws	0.510	-0.587
P2 Tenure	0.382	0.804
P3 Indigenous rights	0.039	1.773
P4 Community	0.598	-0.451
P5 Benefits	0.000	2.875
P6 Environmental Impact	0.533	0.428
P8 Monitoring & Assessment	0.743	0.224
P9 Conservation	0.406	0.616
Constant	0.000	-4.715

As described above, the same *a-priori* expectations (sign and correlation with Canada) are applied to this logistic regression.

As shown in Table 4-6, all coefficients are positively associated with Canada except the predictors: 'compliance with laws' (P1) and 'community relations' (P4). These results are not fully consistent with the signed expectations described above. However, the p-values of these variables (P1 and P4) are not statistically significant.

As detailed above, the Wald statistics and their corresponding significance levels showed that only two predictors are statistically significant: 'indigenous peoples' rights' (P3) and 'benefits from the forest' (P5).

This outcome partially satisfies the *a-priori* expectations. As anticipated, FSC principles 'indigenous peoples' rights' (P3) and 'benefits from the forest' (P5) are likely to be present to a higher level in Canada compared to the US. Also, it was predicted that

FSC principle 'land tenure' (P2) would not be statistically significant as shown in the outcome. By contrast, FSC principles 'environmental impact' (P6), 'monitoring and assessment' (P8), and 'maintenance of high conservation value forests' (P9) exhibited opposite impact as anticipated.

The results for goodness-of-fit tests are presented in Table 4-7:

Table 4- 7 Goodness-of-fit Statistical Tests for Logistic Regression

Test	**Test value**	**P-value**
Cox & Snell R-square	-2 log likelihood= 53.23	p=0.292
Nagelkerke R-square	-2 log likelihood= 53.23	p=0.520
Hosmer and Lemeshow Test	Chi-square= 8.03	p=0.430

The Cox & Snell and Nagelkerke R^2 are equivalent to the Pseudo R^2. In this regression, the results of both statistics were found to be reasonably significant (Cox & Snell=29%, Nagelkerke= 52%). The Hosmer and Lemeshow test the null hypothesis that the model fits the data. If the p-value is 0.05 or less, then the model is discarded. In this regression, the p-value is 0.43, therefore, the estimates of the model fit the data at a reasonable level.

4.10 Discussion

This case study was designed to assess whether or not forest companies from Canada and the US exhibit differences in their application of FSC principles. FSC forest certification reports were assessed by content analysis to examine the presence of FSC principles. The results of the content analysis were then used to pursue descriptive and statistical analyses. Unfortunately, in these statistical analyses, the variable 'management plan' could not be included. Because this principle has a 100% presence in the Canadian sample, this situation creates a lack of variability in the data, and caused problems in applying the statistical methods used in this research.

Results from the descriptive statistics indicate that, for both countries, a high presence was seen of the principles: 'compliance with laws and FSC principles,' 'tenure and use rights and responsibilities,' and 'management plan' (80%, 73%, and 83%, respectively). This situation seems reasonable since, in both countries, law and enforcement in the forestry sector has a high standard of accomplishment. The principles related to 'non-timber benefits,' 'environmental impact,' and 'monitoring and conservation of natural forests,' however, did not have a high presence in the pooled data (26%, 39%, and 48%, respectively). These results are somewhat surprising, especially in these two countries, where societies place a high demand in movements that favour nature conservation.

Outcomes from the statistical analyses show that differences exist in the application of FSC principles in Canada and the US. Results from both statistical methods show that FSC principles related to 'indigenous rights' and to 'benefits from the forest' are more likely followed in Canada, compared to the US ($p<0.05$). In addition, from the logit models, the FSC principles of 'land tenure,' 'community relations,' and 'environmental impact assessment' are also more likely to be observed in Canada rather than in the US ($p\leq0.2$).

Canada and the US have dissimilar types of ownership (property rights), and social, historical, and institutional aspects in their forestry sectors, which might affect the societies' perception of forest values. These dissimilarities might also explain the different emphasis placed on FSC principles, which are applied by forest companies in Canada and the US. Also, the differences might be reflected in the companies' corporate social responsibility, where forest organizations may be disposed to be more responsible for what their stakeholders think is important, based on the social values associated with forests. Unfortunately, corporate social responsibility and its influence in forest certification could not be assessed in the current research study.

In summary, these results support the idea that forest companies in Canada and the US differ in the importance they place on the required FSC principles for forest certification. The principles of 'indigenous people's rights 'and 'forest benefits' are more likely to be present in Canada than in the US.

5. Summary and Conclusions

The two purposes of this study were to assess the application of Criteria and Indicators (C&I) in Canada, and to compare the practice of forest certification in Canada and the US in pursuit of sustainable forest management (SFM). Each of these purposes was pursued with a case study. The objectives for the first case study were to assess whether or not differences exist in the application of C&I, and to determine the emphasis of criteria and elements within and between Model Forests and forest companies in Canada. The objective for the second case study was to investigate the possible differences in the practice of FSC forest certification among forest organizations in Canada and the US.

5.1 Case Study for the C&I of SFM

The literature review identified C&I as an instrument for potentially promoting a common understanding of SFM, monitoring and assessing forest conditions, influencing national forest policies, enhancing practices toward SFM, and reflecting new knowledge, scientific information, and social values. However, very little information is available regarding how C&I in Canada are being used. This case study was focused on assessing the application of SFM-associated elements and criteria used in Model Forests and forest companies in Canada. Accordingly, three main areas were investigated in this research. First, consistency in the application of SFM-associated elements and criteria within Model Forests and within forest companies was researched. Second, ranking of elements and criteria within Model Forests and forest companies was assessed. Finally, dominance, in the most recurrently observed SFM-associated element and criterion in Model Forests and forest companies was investigated.

The first step was to review the set of C&I that has been either proposed or applied by different sources. The primary source of information was the CCFM C&I framework, which is considered to be the primary framework for developing C&I in Canada. The information was complemented with related literature collected from journals, workshops, international organizations, and Model Forests program.

The second step was to collect data and analyze the indicators of SFM used by model forests and forest companies. A comprehensive Internet search was conducted over a period of nine months. The study was focused on five model forests, and seven forest companies whose information on their C&I set was publicly available, and whose C&I data sets followed the CCFM framework for structure of criteria. The sample was comprised of Model Forests and forest companies located in Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, and Ontario. To analyse the indicators, content analysis was used. By examining the content of C&I, it was possible to assess whether or not indicators of SFM were constructed according to the criteria mentioned in the literature, with regards to sustainability indicators and the CCFM C&I framework.

The third step was to apply statistical analyses to evaluate possible differences in the application of criteria and SFM-associated elements within and between Model Forests and forest companies. At first, differences in the application of each SFM-associated element and criteria, within groups (i.e. within Model Forests, within forest companies, and within pooled samples) were estimated to assess the degree of dispersion of these elements and criteria. The analyses were carried out by using the χ^2 test. Next, the relative magnitude of SFM-associated elements and criteria within groups was appraised to estimate the relative importance of these elements and criteria. For this purpose, the Mann-Whitney U test, Kruskal-Wallis, and Dunn's tests were carried out. At last, the most prevalently applied SFM-associated element and criterion, between Model Forests and forest companies, were estimated to evaluate the possible differences in the application of these elements and criteria.

The final step in this case study was to present the results from the statistical analyses. The results are summarized in Table 5.1.

As depicted in the first two columns of this table, results showed that no significant differences were present in implementing SFM-associated elements, but a few inconsistencies show up at the criteria level. In both groups, the application of the criterion, 'multiple benefits to society' was not uniformly cited. In addition, forest companies were inconsistent in citing the criteria: 'conservation of soil and water resources,' and 'accepting society's responsibility for sustainable development.' The greater conformity among model forests makes it appear as though Model Forests may have been following established criteria and indicators a bit closer than forest companies.

From the third and fourth columns of Table 5-1, results showed model forests and forest companies generally attributed similar importance to the various criteria and elements. Specifically, there are no differences exhibited in their first place ranked criterion and SFM-associated elements. The only discrepancy exists at the element level in the criterion 'accepting society's responsibility for sustainable development. Model Forests place a priority on the 'informed decision-making' element. In support of this finding, it is important to remember that Model Forests emphasize the participation of different stakeholders in forest management. On the other hand, forest companies emphasize 'participation by aboriginal communities.' In this regard, it is important to note that forest companies working on Crown lands face constraints and legal requirements associated with Aboriginal issues, and the result might illustrate their responsibility on this issue.

Table 5- 1 Summary of Results from the Case Study on C&I

Criteria/Elements	Consistency within Model Forests	Consistency within Forest Companies	Ranking of Criteria/ Elements By Model Forests	Ranking of Criteria/ Elements by Forest Companies	Prevalence of occurrence among Model Forests vs. Forest Companies
Equity					
Inter-generational	YES	YES	1	1	Forest Companies
Intra-generational	YES	YES	2	2	Model Forests
Sustainability					
Economic	YES	YES	1	1	NSD[a]
Environmental	YES	YES	2	2	Forest Companies
Social	YES	YES	3	3	NSD
Level					
Community	YES	YES	1	1	Forest Companies
Regional–provincial	YES	YES	2	2	Model Forests
C1 Biological diversity	YES	YES	2	4	NSD
Ecosystem diversity	YES	YES	1	1	NSD
Species diversity	YES	YES	2	2	NSD
Genetic diversity	YES	YES	3	3	NSD
C2 Ecosystem condition and	YES	YES	4	6	NSD
Disturbance and stress	YES	YES	2	2	NSD
Ecosystem resilience	YES	YES	1	1	Forest Companies
Extent biomass	YES	YES	3	3	Model Forests
C3 Conservation of soil and water	YES	NO	6	3	NSD
Physical-environ. Factors	YES	YES	1	1	NSD
Policy-protection factors	YES	YES	2	2	NSD
C4 Contribution to global cycles	YES	YES	5	5	NSD
Global carbon budget	YES	YES	1	1	Forest Companies
Forest land conversion	YES	YES	3	3	NSD
Forest carbon dioxide	YES	YES	4[b]	4	NSD
Forest sector policy factors	YES	YES	4[b]	5	Model Forests
Hydrological cycles	YES	YES	2	2	Model Forests
C5 Multiple benefits to society	NO	NO	1	1	NSD
Productive capacity	YES	YES	1	1	NSD
Competitiveness industries	YES	YES	3	4	Model Forests
Contribution national economy	YES	YES	4	3	NSD
Non-timber values	YES	YES	2	2	NSD
C6 Society's responsibility for SD	YES	NO	3	2	NSD
Aboriginal and treaty rights	YES	YES	4[c]	4	NSD
Participation by aboriginal communities	YES	YES	2	1	Forest Companies
Sustainability of forest communities	YES	YES	3	5	Model Forests
Fair and effective decision-making	YES	YES	4[c]	3	NSD
Informed decision making	YES	YES	1	2	Model Forests

[a] NSD stands for 'no-significant-differences' between model forests and forest companies.

[b,c] Duplicated numbers represent tied results.

Finally, the last column in Table 5-1 shows that 21 out of 35 SFM-associated elements and criteria have no differences in their prevalence, in comparing Model Forests and forest companies (60%). By contrast, in 14 SFM-associated elements (40%), a distinct prevalence was seen that allows for a differentiation between Model Forests and forest companies. Thus, one could speculate that these differences might be associated with the roles, functions, duties, and legal obligations of the organizations. However, no obvious pattern of differentiation emerges. Reasons behind these differences leave us with an open and intriguing question that requires further investigation.

5.2 Limitations and Future Research on Case Study on Criteria and Indicators for Sustainable Forest Management

The findings of this study are subject to a number of limitations. This case study was limited by its small sample size. The data was collected using purposive sampling, and the sources included the Internet and/or personal contacts. The use of non-random sampling could imply that the results are not representative of the population. Therefore, it is difficult to assess how generally applicable these results are. In addition, as an important limitation, no survey was carried out through model forest and forest companies to check how SFM-associated indicators are being applied in the forest.

Future research could expand the findings of this study in a number of directions. First, the reason for some SFM-associated elements and criteria being addressed differently within Model Forests and forest companies could be explored. Research in this area could contribute to an understanding of possible perceptions of SFM, and to detect the priorities of an organization in achieving SFM.

Second, how social, economic, and environmental indicators are selected and validated by interested groups could be evaluated. The analysis would provide information about how to balance SFM-associated elements and criteria, to achieve SFM, and to elucidate whether or not C&I-applying organizations understand the role, application, and contribution of C&I to enhancing SFM.

Third, investigations of how model forests and forest companies operate would be useful, going beyond monitoring and reporting, with the information provided by the SFM indicators. This research could contribute to enhancing the decision-making process within organizations, and to provide feedback to provincial and federal government for a future redefinition of C&I in Canada.

Finally, research is needed to assess how indicators should properly address sustainability aspects that are not yet included, i.e., institutional development, productivity, investment, and technological change. Moreover, research could be oriented to developing indicators for non-wood and non-market goods and services. In this case-study, the indicators for these goods and services are largely neglected in Model Forests and forest companies in Canada.

5.3 Case Study on Forest Certification

Forest certification constitutes a market instrument used by forest companies to inform and educate consumers about whether or not wood and wood-products achieve the defined sustainability principles. Moreover, forest certification is meant to facilitate objectives of SFM, retain or increase market shares of firms, and provide a means of communicating positive aims to the public from the forest industry. This case study was focused on assessing whether or not FSC-certified forest organizations in Canada and the US apply the FSC requirements differently.

In pursuit of these purposes, the first step was to review literature on forest certification. The primary source of information was the FSC forest principle set. This document contains the principles, criteria, and elements that forest organizations apply to become certified under this scheme. This information was supplemented with related literature collected from other forest certification schemes and published papers.

The second step was to collect FSC forest certification reports. This research used available public information, especially from the Internet. As of December 2003, 17 FSC-certified forests were located in Canada and 100 were in the US. In this study, the sample comes from 111 FSC public reports (16 in Canada and 95 in the US) and corresponds to 95% of the total FSC forest certified organizations in Canada and the US.

The third step was to examine the FSC forest certification reports, to collect information related to FSC forest principles. This data collection was carried out using content analysis. As such, the existence of FSC forest principles in public reports was checked.

The fourth step was to perform descriptive and statistical analyses. In this case study, binomial logit and logistic regression models were applied to evaluate whether or not differences exist among FSC-certified forest organizations. By using two different methods, the findings could be compared with a greater confidence in the statistical results. A binomial logit model was used to investigate the association of each FSC principle (dependent variable) to Canada and the US (the independent variable). By using this model, differences in each FSC principle associated with each country was tested independently. Next, a logistic regression was used to identify the relationship among FSC principles (set of predictors), and differences in their implementation between Canada and the US forest companies (response variable) simultaneously.

The last step was to discuss outcomes from the descriptive and statistical analyses. The outcomes showed that FSC principles of 'compliance with laws and FSC principles,' 'tenure and use rights and responsibilities,' and 'management plan' are highly visible in both countries. For Canada, the descriptive analysis exhibited a higher observance rate for all principles, compared to the US. Also, for Canada, the highest observed FSC principle is 'management plan' (100%) and the lowest is 'environmental impact' (56%). For the US, the highest observed FSC principle is 'compliance with laws and FSC principles' (80%) and the lowest is 'benefits from the forest' (18%). The results from the statistical analyses showed the relationships between dependent and independent variables (logit model), among a set of predictors. In addition, response variables (logistic model) were reported at different p-values. Depending on the p-value, three types of relationships were defined: strong ($p<0.05$), weak ($0.05<p<0.2$), and no relationship ($p>0.2$). These relationships are associated to the data from Canada. A summary of these results is presented in Table 5-2:

Table 5- 2 Summary of Results from the Forest Certification Case Study

FSC Forest Principle	**Relationship**	
	Logit Models	**Logistic Regression**
1 Compliance with laws and FSC principles	No relationship	No relationship
2 Tenure and use rights and responsibilities	Weak	No relationship
3 Indigenous rights	Strong	Strong
4 Community relations and worker's rights	Weak	No relationship
5 Benefits from the forest	Strong	Strong
6 Environmental impact	Weak	No relationship
7 Management plan[a]	—	—
8 Monitoring and assessment	No relationship	No relationship
9 Maintenance of high conservation value forests	No relationship	No relationship

[a] This principle could not be statistically tested because it was used by 100% of the Canadian sample.

In Table 5-2, the results from the logit models show the presence of differences between the countries and in each FSC principle, when each variable is considered independently. The principles that are strongly correlated with Canada are 'indigenous rights' and 'benefits from the forest,' whereas, those having a weak relationship are 'tenure and use rights,' 'community relations and worker's rights,' and 'environmental impact.' As stated in Section 4.4, differences between Canada and the US, specifically in land ownership and aboriginal issues, might justify a particular emphasis being placed on FSC principles by forest organizations in these countries.

The result from the logistic regression is also shown in Table 5-2. This procedure is particularly beneficial since: 1) no a priori relationship is assumed to exist among variables, and 2) the relationship between predictors and response variable could be simultaneously estimated. The strong variables in the logit models were also strong in the logistic regressions, while all weak variables became insignificant. That is, the differential importance to Canada of the FSC principles related to 'indigenous rights' and 'benefits from the forest' hold in both types of tests.

Although this study does not specifically investigate why these principles are different, the discussion in Section 4.10 suggests that this outcome may be created by: 1) differences between Canada and the US in aspects such as property rights, social, historical, and institutional aspects in their forestry sectors; and 2) differences in the values that Canadian and American societies might place on forests. Nevertheless, the full explanation is beyond the scope of this research and could be the subject for future research.

5.4 Limitations and Future Research in Forest Certification Case Study

This study exhibited several limitations. First, it only evaluates the FSC forest certification scheme and not other certification systems such as the Canadian Standards Association, Sustainable Forestry Initiative, and Pan-European Forest Certification, etc. Therefore, the findings may not necessarily be generalized to other forest certification systems in current use. Future research should therefore compare the FSC certification system, with applications of other forest certification systems used in Canada and the US. Furthermore, future research could be expanded to other developed and developing countries to understand how forest sustainability principles are used in other areas and to appreciate the social values that are driving forest management in different countries.

Second, this case study did not assess what specific reasons were responsible for differences in application of FSC forest certification between Canada and the US. The differences could be related to different social values of forests, existing land-use patterns, forest practices and conditions, institutions or biophysical characteristics, etc. In future studies, it may be important to consider how social, ecological, and economic issues drive forest certification processes and influence SFM practices. Moreover, future research should investigate whether forest sustainability is affected by corporate social responsibility. By understanding the role of corporate social responsibility in SFM, new insights would be gained about the environmental behavior of firms.

5.5 Conclusions

The concept of SFM is drawn from 'sustainable development,' an internationally recognized concept that serves as a framework for balancing the use of natural resources, promotion of economic growth, and enhancement of social equity. However, this study has shown that the concept of SFM is subject to various interpretations by country or local areas.

Diverse tools are being used to carry out SFM. Indeed, C&I and forest certification are the two most important. This research has analyzed the application of C&I in Canada, and differences in forest certification between Canada and the US. This research found, in both case-studies, a number of similarities and differences in applying C&I within and between organizations (i.e. Model Forests, forest companies) in Canada, and forest certification. Although speculation could help to clarify the differences, some questions are still unanswered: What do the differences in applying SFM tools mean for sustainable forestry? Should SFM tools be applied in the same way and with the same emphasis?

SFM is considered as a dynamic and evolving concept that not only respects the three aspects of sustainability (economic, social, and ecological), but also reflects and attends to a country's local conditions and sovereignty. Consequently, SFM is not only the result of international agreement but also reflects a country's specific situation. Thus, the international consensus may not necessarily reflect local stakeholders' interests on SFM. In fact, the results from this study show that no single strategy is used to achieve SFM.

Actually, different organizations incorporate social, economic, aboriginal, and environmental values in their operations to achieve SFM. Nevertheless, the wide range of challenges faced by different forest organizations at different levels (i.e., community, provincial/federal, national), along with the particular ecological, social, historical and geographical conditions where the forest operation takes place make specific approaches to SFM critical. If we accept that forest ecosystems have unique characteristics that demand different strategies in their management, and that social values differ across jurisdictions, then we must also accept that a one-size-fits-all approach is not practical for the wide range of economic, social and environmental aspects in forest ecosystems for achieving SFM.

The results of this research support that a one-size-fits-all approach to C&I and forest certification is not realistic. For the development of SFM instruments, like C&I and forest certification, local characteristics, geographic variance, social and environmental diversity, and institutional differences are considered by different organizations in different geographic locations. Thus, the results presented here suggest that, rather than applying stringent and homogeneous concepts in implementing SFM, an appropriate and more specific approach to sustainability would be to respect the unique qualities of different ecosystems, idiosyncrasies of local culture, and the singularities of geographical conditions where forest operations occur.

Many challenges need to be addressed for a proper understanding and application of C&I and forest certification. One challenge would be to inform society that SFM is not a fixed set of management prescriptions or a common definition for all forests, as forest values, a country's conditions, local forest circumstances, and an institutions' characteristics might also influence its application. Therefore, a new understanding of SFM should include how the local variations might affect the application of SFM tools. A greater flexibility in applying SFM tools may be necessary to attract stakeholders and forest practitioners to implement C&I and forest certification. Moreover, flexibility might contribute to promoting and attracting forest practitioners, governments, and other stakeholders to comply with these tools.

In conclusion, through these case studies, a country's sovereignty and the society's values, along with local forest condition and an organization's characteristics are seen to be relevant factors for implementing SFM. In a globalized world, forest sustainability tools might also include a standard definition, and their application should recognize that 'a common understanding about SFM' exists, though a 'global understanding about SFM' may not emerge. The major challenge facing the forestry sector in advancing SFM is in balancing local needs with a global (political) focus, and to promote a two-way interaction between the local and global levels. SFM should identify, include, and maintain the local needs, interests, and points of view, over the long-term. If SFM is conceived in connection with the local circumstances, then implications for theory, policy, and practice should be more relevant for forest management and a stronger stakeholder commitment towards SFM should be possible.

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APPENDIX A

Criteria and Elements in the Revised CCFM C&I Framework

CRITERION	ELEMENT	INDICATORS
Criterion 1: Biological diversity	Element 1.1: Ecosystem diversity	1.1.1 Area of forest, by type and age class, and wetlands in each ecozone. 1.1.2 Area of forest, by type and age class, wetlands, soil types and geomorphological feature types in protected areas in each ecozone.
	Element 1.2: Species diversity	1.2.1 The status of forest-associated species at risk. 1.2.2 Population levels of selected forest-associated species. 1.2.3 Distribution of selected forest-associated species. 1.2.4 Number of invasive, exotic forest-associated species.
	Element 1.3: Genetic diversity	1.3.1 Genetic diversity of reforestation seed-lots. 1.3.2 Status of *in situ* and *ex situ* conservation efforts for native tree species within each ecozone.
Criterion 2: Ecosystem condition and productivity		2.1 Total growing stock of both merchantable and non-merchantable tree species on forest land. 2.2 Additions and deletions of forest area, by cause. 2.3 Area of forest disturbed by fire, insects, disease and timber harvest. 2.4 Area of forest with impaired function due to ozone and acid rain. 2.5 Proportion of timber harvest area successfully regenerated.
Criterion 3: Soil and water		3.1 Rate of compliance with locally applicable soil disturbance standards. 3.2 Rate of compliance with locally applicable road construction, stream crossing and riparian zone management standards. 3.3 Proportion of watersheds with substantial stand-replacing disturbance in the last 20 years.
Criterion 4: Role in global ecological cycles	Element 4.1: Carbon cycle	4.1.1 Net change in forest ecosystem carbon. 4.1.2 Forest ecosystem carbon storage by forest type and age class. 4.1.3 Net change in forest products carbon. 4.1.4 Forest sector carbon emissions.

CRITERION	ELEMENT	INDICATORS
Criterion 5: Economic and social benefits	Element 5.1: Economic benefits	5.1.1 Contribution of timber products to the gross domestic product. 5.1.2 Value of secondary manufacturing of timber products per volume harvested. 5.1.3 Production, consumption, imports and exports of timber products. 5.1.4 Contribution of non-timber forest products and forest-based services to the gross domestic product. 5.1.5 Value of unmarketed non-timber forest products and forest-based services.
	Element 5.2: Distribution of benefits	5.2.1 Forest area by timber tenure. 5.2.2 Distribution of financial benefits from the timber products industry.
	Element 5.3: Sustainability of benefits	5.3.1 Annual harvest of timber relative to the level of harvest deemed to be sustainable. 5.3.2 Annual harvest of non-timber forest products relative to the levels of harvest deemed to be sustainable. 5.3.3 Return on capital employed. 5.3.4 Productivity index. 5.3.5 Direct, indirect and induced employment. 5.3.6 Average income in major employment categories.
Criterion 6: Society's responsibility	Element 6.1: Aboriginal and treaty rights	6.1.1 Extent of consultation with aboriginals in forest management planning and in the development of policies and legislation related to forest management. 6.1.2 Area of forest land owned by aboriginal peoples.
	Element 6.2: Aboriginal traditional land use and forest-based ecological knowledge	6.2.1 Area of forested crown land with traditional land use studies.
	Element 6.3: forest community well-being and resilience	6.3.1 Economic diversity index of forest-based communities. 6.3.2 Education attainment levels in forest-based communities. 6.3.3 Employment rate in forest-based communities. 6.3.4 Incidence of low income in forest-based communities.
	Element 6.4: fair and effective decision-making	6.4.1 Proportion of participants who are satisfied with public involvement processes in forest management in Canada. 6.4.2 Rate of compliance with sustainable forest management laws and regulations.
	Element 6.5: Informed decision-making	6.5.1 Coverage, attributes, frequency and statistical reliability of forest inventories. 6.5.2 Availability of forest inventory information to the public. 6.5.3 Investment in forest research, timber products industry research and development, and education. 6.5.4 Status of new or updated forest management guidelines and standards related to ecological issues.

(Adapted from CCFM, 2003)

APPENDIX B

Concepts associated with Criteria and Elements drawn from the Literature Review and CCFM Framework that were used in this study

	CRITERIA	ELEMENT	INDICATOR -CONCEPTS
CRITERIA FROM LITERATURE REVIEW	Equity	Focus on intra generational equity	Intragenerational Equity[2]: entails distributing the environmental costs and benefits among people living now
		Focus on inter generational equity	Intergenerational Equity[3] responsibility of each generation to ensure that the next one receives undiminished natural and economic capital, or leaving future generations an ecologically viable planet with abundant resources
	Sustainability	Includes economic aspect	Economic: of, relating to, or based on the production, distribution, and consumption of goods and services
		Includes social aspect	Social: of or relating to human society , the interaction of the individual and the group, or the welfare of human beings as members of society
		Includes environmental aspect	Environmental: the complex of physical, chemical, and biotic factors (as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival
	Level	Community	Indicator was constructed at community level
		Regional-Provincial	Indicator was constructed at regional provincial level
	Ecosystem goods and services	Address ecosystem goods and services	Ecosystem Non-Market Services[4] are those which are provided free or at prices which are not economically significant (i.e., prices which will not significantly affect the amounts that producers are willing to supply or the amounts purchasers wish to buy). (Most environmental services, such as aesthetic, that are not traded in markets) services5-the beneficial outcomes that result from ecosystem functions (e.g., better fishing and hunting, cleaner water, better views, reduced human health and ecosystem risks). These require some interaction with, or at least some appreciation by, humans, but can be measured in physical terms (e.g., catch rates, water quality, and property damage avoided). These depend on ecosystem functions and certain aspects of landscape context (e.g., proximity to floodwaters, people, and property; accessibility to hunters, birders, fishermen). Ecosystem Non-Market Goods[6] Most environmental goods, such as clean air and water, and healthy fish and wildlife populations, are not traded in markets. Goods represent the supplies, commodities or products that humans derive from functioning ecological systems.

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[2] Farrell and Hart (1998). What Does Sustainability Really Mean? The Search for Useful Indicators, Environment, 4, November 1998.

[3] Scruggs, Patricia. "Chapter one: definition and principles." - p. 3-8. In Guidelines For State Level Sustainable Development. Washington, D.C.: Center for Policy Alternatives, 1993.

[4] Organisation for Economic Co-operation and Development.(1997) Productivity Measurement For Non-Market Services. STD/NA(97)14. http://www.oecd.org/dataoecd/17/56/2666071.pdf

[5] Ecosystem Valuation. (2004). Definition of Terms. http://www.ecosystemvaluation.org/Indicators/economvalind.htm

[6] Ecosystem Valuation. (2004). Definition of Terms. http://www.ecosystemvaluation.org/Indicators/economvalind.htm

	CRITERIA	ELEMENT	INDICATOR –CONCEPTS
CRITERIA CCFM	Criterion 1 Conservation of biological diversity	Includes ecosystem diversity	• Variety and pattern of communities and ecosystems. • Maintenance of the variety and quality of the earth's ecosystems. • Percentage and extent, in area, of forest types relative to historical condition and to total forest area • Percentage and extent of area by forest type and age class • Area, percentage and representativeness of forest types in protected areas • Level of fragmentation and connectedness of forest ecosystem components
		Includes species diversity	• Changes in species population levels • Changes in ecosystem integrity. • Number of known forest-dependent species classified as extinct, threatened, endangered, rare or vulnerable relative to total number of known forest-dependent species • Population levels and changes over time of selected species and species guilds • Number of known forest-dependent species that occupy only a small portion of their former range
		Includes genetic diversity	• Genetic diversity, or the variation of genes within a species • Implementation of an in situ/ex situ genetic conservation strategy for commercial and endangered forest vegetation species
	Criterion 2 Maintenance and enhancement of forest ecosystem condition and productivity	Includes incidence of disturbance and stress	• Levels of air pollutants and the frequency/severity of major biotic and abiotic stresses. • Area and severity of insect attack • Area and severity of disease infestation • Area and severity of fire damage • Rates of pollutant deposition • Ozone concentrations in forested regions • Crown transparency in percentage by class • Area and severity of occurrence of exotic species detrimental to forest condition • Climate change as measured by temperature sums
		Includes ecosystem resilience	• Reflects the persistence of ecosystems and their capacity to absorb change and disturbance • Potential for populations to recover from very low levels by having adequate regenerative capacity and a balanced distribution of forest types and age classes. • Percentage and extent of area by forest type and age class • Percentage of area successfully naturally regenerated and artificially regenerated
		Includes extent biomass	• Condition of the forest in terms of biomass production of all species and types • Mean annual increment by forest type and age class • Frequency of occurrence within selected indicator species (vegetation, birds, mammals, fish)

	CRITERIA	ELEMENT	INDICATOR –CONCEPTS
CRITERIA CCFM	Criterion 3 Conservation of soil and water resources	Includes physical environmental factors	• Area of productive forest soil where the physical ability of the soil to sustain forest growth has been changed. • Proposed measures include the area where land use changes take soil out of forest production or where activities have reduced organic matter levels, compacted soil or led to soil loss through erosion. • Refer to both physical and chemical properties: for example, flow patterns, water temperature, aeration, sediment load, and chemistry which provide for aquatic plant and animal life. Changes in aquatic environments can negatively affect aquatic life. • Percentage of harvested area having significant soil compaction, displacement, erosion, loss of organic matter, etc. • Area of forest converted to non-forest land use, for example, urbanization • Water quality as measured by water chemistry, turbidity, etc. • Trends and timing of events in stream flows from forest catchments • Changes in distribution and abundance of aquatic fauna
		Includes policy and protection forest factors	• Policies are in place which provide for specific management practices or the protection of sensitive sites. • Sensitive site conditions include riparian zones, wet soils, infertile soils, steep slopes and shallow soils over bedrock. • With respect to aquatic systems, policies that address stream crossings, watershed management, and riparian areas will assist in maintaining water flow patterns, water levels, and water quality. • Percentage of forest managed primarily for soil and water protection • Percentage of forest area having road construction and stream crossing guidelines in place • Area, percentage and representativeness of forest types in protected areas
	Criterion 4 Forest ecosystem contributions to global ecological cycles	Includes contributions to the global carbon budget	• Tree biomass volumes, vegetation (non-tree) biomass estimates • Percentage of canopy cover, percentage of biomass volume by general forest type • Soil carbon pools, soil carbon pool decay rates • Area of forest depletion • Forest wood product life cycles, forest sector CO2 emissions
		Includes forest land conversion	• Irreversible forest removals • Area of forest permanently converted to non-forest land use (for example, urbanization) • Semi-permanent or temporary loss or gain of forest ecosystems (for example, grasslands, agriculture)
		Includes forest sector carbon dioxide conservation	• Fossil fuel emissions • Fossil carbon products emissions • Percentage of forest sector energy usage from renewable sources relative to total sector energy requirement
		Includes forest sector policy factors	• Recycling rate of forest wood products manufactured and used in Canada • Participation in the climate change conventions • Economic incentives for bioenergy use • Existence of forest inventories • Existence of laws and regulations on forest land management
		Includes contributions to hydrological cycles	• Changes of water surface area within forests • Surface area of water within forested areas

	CRITERIA	ELEMENT	INDICATOR -CONCEPTS
CRITERIA CCFM	Criterion 5 Multiple benefits of forests to society	Includes productive capacity	• Annual removal of forest products relative to the volume of removals determined to be sustainable • Distribution of, and changes in, the land base available for timber production • Animal population trends for selected species of economic importance • Management and development expenditures • Availability of habitat for selected wildlife species of economic importance
		Includes competitiveness of resource industries	• Net profitability • Trends in global market share • Trends in research and development expenditures in forest products and processing technologies
		Includes contribution to the national economy	• Distribution of wealth. It also requires consideration of the way in which wealth from development is distributed to society. Wealth from forest use flows to Canadians through the market economy (which can be measured with economic indicators such as gross domestic product and employment) and through the subsistence economy (involving income in-kind from the extraction and use of fuel wood; building materials; meat, fish, and fur products among others). • Contribution to gross domestic product (GDP) of timber and non-timber sectors of the forest economy • Total employment in all forest-related sectors • Utilization of forests for non-market goods and services, including forest land use for subsistence purposes • Economic value of non-market goods and services
		Includes non-timber values	• A wide range of non-timber values are associated with forests including recreation values, tourism values, existepce values, and option values. • Availability and use of recreational opportunities • Total expenditures by individuals on activities related to non-timber use • Membership and expenditures in forest recreation-oriented organizations and clubs • Area and percentage of protected forest by degree of protection

	CRITERIA	ELEMENT	INDICATOR –CONCEPTS
CRITERIA CCFM	Criterion 6 Accepting society's responsibility for sustainable development	Includes aboriginal and treaty rights	• Existing Aboriginal and treaty rights are recognized • Aboriginal and treaty rights are respected, they should be considered in the context of sustainable forest management. • Take into consideration rights relate to hunting, fishing and trapping, and in some cases, gathering. • Forest management and planning processes should be designed, as far as possible, with input from involved Aboriginal communities, as well as other affected groups and communities. • Final plans should reflect the options considered and actions taken with respect to duly established Aboriginal and treaty rights. • Extent to which forest planning and management processes consider and meet legal obligations with respect to duly established Aboriginal and treaty rights
		Includes participation by aboriginal communities in sustainable forest management	• The cultural and spiritual connection between Aboriginal communities and forests is acknowledged. • Increased cooperation between Aboriginal communities and all forest stakeholders is important to achieving the goals of sustainable forest management. • Extent of Aboriginal participation in forest-based economic opportunities, and extent to which forest management planning takes into account the protection of unique or significant Aboriginal social, cultural or spiritual sites • Number of Aboriginal communities with a significant forestry component in the economic base and the diversity of forest use at the community level • Area of forest land available for subsistence purposes, and area of Indian reserve forest lands under integrated management plans
		Includes sustainability of forest communities	• Decision-making processes that are removed from communities, or that do not consider social costs associated with community instability, do not contribute to sustainable development. • Number of communities with a significant forestry component in the economic base • Index of the diversity of the local industrial base, and diversity of forest use at the community level • Number of communities with stewardship or co-management responsibilities
		Includes fair and effective decision making	• Degree of public participation in the design of decision-making processes
		Includes informed decision making	• The extent to which these institutions effectively incorporate the full range of social values in decisions and the responsiveness of institutions to change in values over time are a determining factor in monitoring progress toward sustainable development. • Degree of public participation in decision-making processes • Degree of public participation in implementation of decisions and monitoring of progress toward sustainable forest management

Coding Form that contains Criteria drawn from the Literature Review and CCFM Framework

Indicator ID

Equity
Focus on intra generational equity__________
Focus on inter generational equity__________

Sustainability
Includes economic aspect__________
Includes social aspect__________
Includes environmental aspect__________

Level of application
Community__________
Regional-Province __________

Ecosystem goods and services
Address ecosystem goods __________
Address ecosystem goods and services__________

Criterion 1 Conservation of biological diversity
1.1 Includes ecosystem diversity__________
2 Includes species diversity__________
1.3 Includes genetic diversity__________

Criterion 2 Maintenance and enhancement of forest ecosystem condition and productivity
2.1 Includes incidence of disturbance and stress__________
2.2 Includes ecosystem resilience__________
2.3 Includes extent biomass __________

Criterion 3 Conservation of soil and water resources
3.1 Includes physical environmental factors__________
3.2 Includes policy and protection forest factors__________

Criterion 4 Forest ecosystem contributions to global ecological cycles
4.1. Includes contributions to the global carbon budget__________
4.2. Includes forest land conversion __________
4.3. Includes forest sector carbon dioxide conservation__________
4.4. Includes forest sector policy factors__________
4.5. Includes contributions to hydrological cycles __________

Criterion 5 Multiple benefits of forests to society
5.1. Includes productive capacity__________
5.2. Includes competitiveness of resource industries__________
5.3. Includes contribution to the national economy__________
5.4. Includes non-timber values __________

Criterion 6 Accepting society's responsibility for sustainable development
6.1. Includes aboriginal and treaty rights__________
6.2. Includes participation by aboriginal communities in sustainable forest management__________
6.3. Includes sustainability of forest communities__________
6.4. Includes fair and effective decision making __________
6.5. Includes informed decision making__________

APPENDIX C

List of Professionals Consulted for the C&I Case Study

Name	Current Position	Studies	Contact
Carlos Noton	Chilean representative in Convention on Biological Diversity, UNFF, IUCN and Montreal Process	Forest Engineer MSc Environmental Policy and Rural Resources WYE College University of London	cnoton@conaf.cl
Esteban Duran	Researcher Forest Analysis Office Chilean Forest Service	B.S. Sociology	eduran@conaf.cl
Andres Meza	Forest Engineer Doctorant à l'Ecole National du Génie Rural des Eaux et des Forêts (ENGREF), Paris. France Research: Gestion durable des forêts, critères et indicateurs et normes forestières.	Diplôme d'Études Approfondies - DEA. Université Orléans, Muséum National d'Histoire Naturel, France	andres.meza@wanadoo.fr
Carlos Weber	Executive Director – Chilean Forest Service	Master of Science, State University of New York, College of Environmental Science and Forestry	cweber@conaf.cl

APPENDIX D

Statistical Analyses Results for the C&I Case Study

D.1 *Equity*

Table D-1- a χ^2 Test for Differences of Percentages of Indicator-concepts for Inter-generational and Intra-generational Elements within Each Group and Pooled Sample

	Element: Intra-generational			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	1.051	9	0.999
Forest Companies	7	0.534	13	1
Both	12	1.598	23	1
	Element: Inter-generational			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	1.051	9	0.999
Forest Companies	7	0.534	13	1
Both	12	1.598	23	1

Table D-1- b Mann-Whitney U Test for Differences of Percentages of Indicator-concepts between Inter-generational and Intra-generational Elements by Groups

GROUP	n=	Z =	p-value
Model Forests	5	-2.627	0.008
Forest Companies	7	-3.158	0.001
Both	12	-4.166	0.000

Table D-1- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of Inter-generational and Intra-generational Elements between Model Forests and Forest Companies [18]

ELEMENTS	Z =	p-value
Inter-generational	-2.867	0.004
Intra-generational	-2.867	0.004

D.2 *Sustainability*

Table D-2- a Test for Differences of Percentages of Indicator-concepts for Economic, Social and Environmental Elements within Each Group and Pooled Sample

	Element: Economic			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.091	9	1
Forest Companies	7	1.132	13	1
Both	12	1.226	23	1
	Element: Social			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.479	9	1
Forest Companies	7	5.451	13	0.965
Both	12	5.913	23	1
	Element: Environmental			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.616	9	1
Forest Companies	7	1.972	13	1
Both	12	2.563	23	1

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[18] Significance of differences between 'inter-generational' and 'intra-generational' are the same for both elements because the percentages of the two elements sum up to 1.

Table D-2- b Kruskal–Wallis Test for Differences of Percentages of Indicator-concepts among Economic, Social and Environmental Elements by Groups

GROUP	n=	$\chi^2=$	df =	p-value
Model Forests	5	12.507	2	0.002
Forest Companies	7	16.871	2	0.000
Both	12	30.674	2	0.000

Table D-2- c Mann-Whitney U Test for Differences for Differences of Percentages of Indicator-concepts of Economic, Social and Environmental Elements between Model Forests and Forest Companies

ELEMENTS	Z =	p-value
Economic	-0.26	0.795
Social	-1.22	0.222
Environmental	-1.96	0.049

D.3 *Level*

Table D-3- a $\chi 2$ Test for Differences of Percentages of Indicator-concepts for Community and Region-Provincial Level Elements within Each Group and Pooled Sample

	Element: Community Level			
GROUP	n=	$\chi^2=$	df =	p-value
Model Forests	5	3.26	9	0.920
Forest Companies	7	1.96	13	0.999
Both	12	5.22	23	0.999
	Element: Region-Provincial Level			
GROUP	n=	$\chi^2=$	df =	p-value
Model Forests	5	3.26	9	0.920
Forest Companies	7	1.96	13	0.999
Both	12	5.22	23	0.999

Table D-3- b Mann-Whitney U Test for Differences of Percentages of Indicator-concepts between Community and Region-Provincial Level Elements by Groups

GROUP	n=	Z =	p-value
Model Forests	5	2.51	0.012
Forest Companies	7	3.07	0.002
Both	12	4.13	0.000

Table D-3- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of Community and Region-Provincial Level Elements between Model Forests and Forest Companies[19]

ELEMENTS	Z =	p-value
Community	-2.68	0.007
Regional Provincial	-2.68	0.007

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[19] Significance of differences between 'community' and 'regional-provincial' level are the same for both elements because the percentages of the two elements sum up to 1.

D.4 *CCFM Criteria*

Table D-4- a χ2 Test for Differences of Percentages of Indicator-concepts for CCFM Criteria within Each Group and Pooled Sample

	Criterion 1: Conservation of Biological Diversity			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	9.791	9	0.368
Forest Companies	7	8.192	13	0.831
Both	12	18.319	23	0.740
	Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	1.135	9	0.998
Forest Companies	7	7.448	13	0.878
Both	12	8.877	23	0.996
	Criterion 3: Conservation of Soil and Water Resources			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	2.977	9	0.965
Forest Companies	7	24.836	13	0.024
Both	12	29.964	23	0.150
	Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	6.151	9	0.725
Forest Companies	7	14.88	13	0.315
Both	12	21.184	23	0.570
	Criterion 5: Multiple Benefits of Forest to Society			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	17.467	9	0.042
Forest Companies	7	22.696	13	0.045
Both	12	40.470	23	0.014
	Criterion 6: Accepting Society's Responsibility for Sustainable Development			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	2.621	9	0.977
Forest Companies	7	32.784	13	0.002
Both	12	35.418	23	0.047

Table D-4- b Kruskal–Wallis Test for Differences of Percentages of Indicator-concepts among CCFM Criteria by Groups

GROUP	n=	χ^2=	df =	p =
Model Forests	5	15.573	5	0.082
Forest Companies	7	12.386	5	0.031
Both	12	24.518	5	0.002

Table D-4- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of CCFM Criterion between Model Forests and Forest Companies

CRITERIA	Z =	p-value
Criterion 1: Conservation of Biological Diversity	-0.571	0.568
Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity	-0.992	0.321
Criterion 3: Conservation of Soil and Water Resources	-1.224	0.221
Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles	-1.082	0.279
Criterion 5: Multiple Benefits of Forest to Society	-0.813	0.416
Criterion 6: Accepting Society's Responsibility for SD	-0.246	0.806

D.5 *Criterion 1 Conservation of biological diversity*

Table D-5- a $\chi 2$ Test for Differences of Percentages of Indicator-concepts for SFM-associated Elements in Criterion 1: Conservation of Biological Diversity within Each Group and Pooled Sample

	Element: Ecosystem diversity			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	1.221	9	0.999
Forest Companies	7	1.709	13	1
Both	12	2.93	23	1
	Element: Species diversity			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	2.954	9	0.966
Forest Companies	7	1.451	13	1
Both	12	4.406	23	1
	Element: Gene diversity			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	1.373	9	0.998
Forest Companies	7	0.678	13	1
Both	12	2.097	23	1

Table D-5- b Kruskal–Wallis Test for Differences of Percentages of Indicator-concepts among SFM-associated Elements in Criterion 1: Conservation of Biological Diversity by Groups

GROUP	n=	χ^2=	df =	p-value
Model Forests	5	12.277	2	0.002
Forest Companies	7	17.832	2	0.000
Both	12	31.043	2	0.000

Table D-5- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of SFM-associated Elements in Criterion 1: Conservation of Biological Diversity between Model Forests and Forest Companies

ELEMENTS	Z =	p-value
Ecosystem Diversity	-0.163	0.871
Species Diversity	-0.732	0.464
Gene Diversity	-0.976	0.329

D.6 *Criterion 2 Maintenance and enhancement of forest ecosystem condition and productivity*

Table D-6- a $\chi2$ Test for Differences of Percentages of Indicator-concepts for SFM-associated Elements in Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity within Each Group and Pooled Sample

	Element: Stress and disturbance			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	10.909	9	0.282
Forest Companies	7	3.107	13	0.998
Both	12	14.025	23	0.871
	Element: Ecosystem resilience			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.345	23	1
Forest Companies	7	2.554	13	0.999
Both	12	2.911	23	1
	Element: Extent of biomass			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	2.568	9	0.979
Forest Companies	7	1.466	13	1
Both	12	3.991	23	1

Table D-6- b Kruskal–Wallis Test for Differences of Percentages of Indicator-concepts among SFM-associated Elements in Elements Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity by Groups

GROUP	n=	χ^2=	df =	p-value
Model Forests	5	9.711	2	0.008
Forest Companies	7	17.022	2	0.000
Both	12	26.051	2	0.000

Table D-6- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of SFM-associated Elements in Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity between Model Forests and Forest Companies

ELEMENTS	Z =	p-value
Stress and disturbance	-0.407	0.684
Ecosystem resilience	-1.717	0.086
Extent of biomass	-1.708	0.088

D.7 *Criterion 3 Conservation of soil and water resources*

Table D-7- a $\chi2$ Test for Differences of Percentages of Indicator-concepts for SFM-associated Elements in Criterion 3: Conservation of Soil and Water Resources within Each Group and Pooled Sample

	Element: Physical and environmental factors			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	3.633	9	0.934
Forest Companies	7	8.412	13	0.816
Both	12	12.029	23	0.972
	Element: Policy and protection factors			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	3.611	9	0.935
Forest Companies	7	8.399	13	0.814
Both	12	12.018	23	0.965

Table D-7- b Mann-Whitney U Test for Differences of Percentages of Indicator-concepts between SFM-associated Elements in Criterion 3: Conservation of Soil and Water Resources by Groups

GROUP	n=	Z =	p-value
Model Forests	5	-2.402	0.016
Forest Companies	7	-3.009	0.003
Both	12	-3.18	0.001

Table D-7- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of SFM-associated Elements in Criterion 3: Conservation of Soil and Water Resources between Model Forests and Forest Companies[20]

ELEMENTS	Z =	p-value
Physical and Environmental Factors	-0.082	0.935
Policy and Protection Factors	-0.082	0.935

D.8 *Criterion 4 Forest ecosystem contributions to global ecological cycles*

Table D-8- a $\chi 2$ Test for Differences of Percentages of Indicator-concepts for SFM-associated Elements in Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles within Each Group and Pooled Sample

	Element: contributions to the global carbon budget			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.658	9	1
Forest Companies	7	3.271	13	0.997
Both	12	3.847	23	1
	Element: forest land conversion.			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.323	23	1
Forest Companies	7	8.274	13	0.825
Both	12	8.488	23	0.997
	Element: forest sector carbon dioxide conservation			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.413	9	1
Forest Companies	7	2.222	13	1
Both	12	2.675	23	1
	Element: forest sector policy factors			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.411	9	1
Forest Companies	7	0.686	13	1
Both	12	1.066	23	1
	Element: contributions to hydrological cycles			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.810	9	1
Forest Companies	7	7.559	13	0.871
Both	12	8.159	23	0.998

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[20] Significance of differences between 'physical and environmental factors' and 'policy and protection factors' are the same for both elements because the percentages of the two elements sum up to 1.

Table D-8- b Kruskal–Wallis Test for Differences of Percentages of Indicator-concepts among SFM-associated Elements in Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles by Groups

GROUP	n=	χ^2=	df =	p-value
Model Forests	5	18.782	4	0.001
Forest Companies	7	21.907	4	0.000
Both	12	38.873	4	0.000

Table D-8- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of SFM-associated Elements in Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles between Model Forests and Forest Companies

ELEMENTS	Z =	p-value
Contributions to Global Carbon Budget	-2.458	0.014
Forest Land Conversion	-0.896	0.371
Forest Sector Carbon Dioxide Conservation	-1.147	0.251
Forest Sector Policy Factors	-2.359	0.018
Contributions to Hydrological	-1.723	0.085

D.9 *Criterion 5 Multiple benefits of forests to society*

Table D-9- a $\chi 2$ Test for Differences of Percentages of Indicator-concepts for SFM-associated Elements in Criterion 5 Multiple Benefits of Forest to Society within Each Group and Pooled Sample

	Element: contributions to productive capacity			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	2.247	9	0.987
Forest Companies	7	4.294	13	0.988
Both	12	6.538	23	1
	Element: competitiveness of resource industries			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	1.796	9	0.994
Forest Companies	7	2.443	13	0.999
Both	12	4.167	23	1
	Element: contribution to the national economy			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	3.035	9	0.963
Forest Companies	7	4.051	13	0.991
Both	12	7.251	23	0.999
	Element: non-timber values			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	0.829	9	1
Forest Companies	7	2.625	13	0.999
Both	12	3.625	23	1

Table D-9- b Kruskal–Wallis Test for Differences of Percentages of Indicator-concepts among SFM-associated Elements in Criterion 5 Multiple Benefits of Forest to Society by Groups

GROUP	n=	χ^2=	df =	p-value
Model Forests	5	12.226	3	0.016
Forest Companies	7	23.192	3	0.000
Both	12	35.482	3	0.000

Table D-9- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of SFM-associated Elements in Criterion 5 Multiple Benefits of Forest to Society between Model Forests and Forest Companies

ELEMENTS	Z =	p-value
Contribution to productive capacity	-0.569	0.571
Competitiveness of resource industries	-2.033	0.042
Contribution to the national economy	-0.163	0.871
Non-timber values	-0.244	0.807

D.10 *Criterion 6 Accepting society's responsibility for sustainable development*

Table D-10- a χ2 Test for Differences of Percentages of Indicator-concepts for SFM-associated Elements in Criterion 6: Accepting Society's Responsibility for Sustainable Development within Each Group and Pooled Sample

	Element: aboriginal and treaty rights			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	8.747	9	0.461
Forest Companies	7	10.415	13	0.663
Both	12	19.162	23	0.739
	Element: participation by aboriginal communities in sustainable forest management			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	2.836	9	0.971
Forest Companies	7	2.612	13	0.999
Both	12	5.291	23	1
	Element: sustainability of forest communities			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	3.347	9	0.949
Forest Companies	7	2.665	13	0.999
Both	12	5.764	23	1
	Element: fair and effective decision making,			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	4.523	9	0.874
Forest Companies	7	10.183	13	0.679
Both	12	14.706	23	0.771
	Element: informed decision making			
GROUP	n=	χ^2=	df =	p-value
Model Forests	5	3.321	9	0.952
Forest Companies	7	3.163	13	0.997
Both	12	6.511	23	0.992

Table D-10- b Kruskal–Wallis Test for Differences of Percentages of Indicator-concepts among SFM-associated Elements in Criterion 6: Accepting Society's Responsibility for Sustainable Development by Groups

GROUP	n=	χ^2=	df =	p-value
Model Forests	5	12.226	4	0.016
Forest Companies	7	23.206	4	0.000
Both	12	23.634	4	0.000

Table D-10- c Mann-Whitney U Test for Differences of Percentages of Indicator-concepts of SFM-associated Elements in Criterion 6: Accepting Society's Responsibility for Sustainable Development between Model Forests and Forest Companies

ELEMENTS	Z =	p-value
aboriginal and treaty rights	-1.383	0.167
participation by aboriginal communities in sustainable forest management	-2.684	0.007
sustainability of forest communities	-1.711	0.087
fair and effective decision making,	-1.385	0.166
informed decision making	-2.684	0.007

APPENDIX E

FSC Reports Used in the Certification Case Study

CANADA

1. Domtar Forest Resources – Cornwall
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/domtarcornwallfmpubsum03.pdf

2. Domtar Forest Resources – Trenton Resource Manager
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/domtar-forest.pdf

3. Eastern Ontario Model Forest
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/eastern-ontario.pdf

4. Groupement Forestier de l'Est du Lac Temiscouata Inc.
Certification Code: SW-FM/COC-191
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/temiscouata.pdf

5. Haliburton Forest and Wildlife Reserve Ltd.
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/haliburton.pdf

6. Harrop-Procter Community Co-operative (SA-fm/coc-1231)
http://www.soilassociation.org/web/sa/saweb.nsf/b0062cf005bc02c180256a6b003d987f/674f31536112111b480256e21003f4c30!OpenDocument

7. Nagaya Forest Restoration, Ltd.
Certification Code: SW-FM/COC-214
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/nagaya.pdf

8. Nipissing Forest
http://www.scscertified.com/PDFS/forest_Nipissing.pdf

9. Pictou Landing First Nation
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/pictou.pdf

10. Regional Municipality of York Certificate Number: SW-FM/COC-115
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/york.pdf

11. Tembec Inc. – Gordon Cosens Forest
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/tembec.pdf

12. Tembec Tree Farm License 14
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/tembeclicense14fmpubsum04.pdf

13. Woodlot 0082 (SA-FM/COC-1281)
http://www.soilassociation.org/web/sa/saweb.nsf/b0062cf005bc02c180256a6b003d987f/b78aeed0759a419680256e21003ecc79!OpenDocument

14. Woodlot 0588 (SA-FM/COC-1243)
http://www.soilassociation.org/web/sa/saweb.nsf/b0062cf005bc02c180256a6b003d987f/c61aee8172c439aa80256e21003ee005!OpenDocument

15. Woodlot 0550 (SA-FM/COC-1242)
http://www.soilassociation.org/web/sa/saweb.nsf/b0062cf005bc02c180256a6b003d987f/a97e4dfc716e307c80256ed80050a328!OpenDocument

16. Woodlot Stewardship Cooperative (SA-FM/COC-1264)
http://www.soilassociation.org/web/sa/saweb.nsf/b0062cf005bc02c180256a6b003d987f/036b878c3a7ee2c480256ed800517178!OpenDocument

USA

1. Aitkin County, Division of Forestry, Minnesota Department of Natural Resources 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/aitkin-county.pdf

2. Aitkin County Land Department 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/aitkincountyfmpubsum04.pdf

3. Allan Waelchli, Consulting Forester 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/waelchli.pdf

4. Anderson-Tully Company 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/anderson-tully.pdf

5. Arcata City Forest Certificate Number: SW-FM-040
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-CA-ArcataCityForest.pdf

6. Baxter State Park Authority Scientific Forest Management Area 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/baxter.pdf

7. Beebe Family TrustsCertification Code: SW-FM/COC-151
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-OR-BeebeFamilyTrusts.pdf

8. Bevan Forestry 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/bevan.pdf

9. Big Creek Forestry Certificate Number: SW-FM/COC-109
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-CA-SanMateo-BigCreekForestry.pdf

10. Blencowe and Associates 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/blencowe.pdf

11. Brunkow Hardwood Corporation 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/brunkow.pdf

12. Cass County Land Department 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/cass-county.pdf

13. Chris W. Olson Forestry Certification Code: SW-FM/COC-171

14. City of Astoria, Oregon certification registration number SCS-FM/COC-00053N
http://www.scscertified.com/PDFS/forest_astoria.pdf

15. Clark Forestry, Inc. Certificate Number: SW-FM/COC-096

16. Collins Almanor Forest Collins Pine Company Chester, California Certificate Number: SCS-FM-00006
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-CA-Chester-CollinsAlmanor1993.pdf

17. Collins Lakeview Forest certification registration number SCS-FM/COC-00012N
http://www.scscertified.com/PDFS/forest_collinslakeview.pdf

18. Collins Pennsylvania Forest Certificate Number: SCS-FM/COC-00007N
http://www.scscertified.com/PDFS/forest_collinspenn.pdf

19. Community Forestry Resource Center 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/community-resource-center.pdf

20. Columbia West Virginia Corporation 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/columbiawestvirginaifmpubsum04.pdf

21. Domtar Industries, Inc. 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/domtarindustriesfmpubsum04.pdf

22. Duke University, Duke Forest 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/duke.pdf

23. Ecoforestry Institute Certificate Number: SW-FM-043
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-OR-Glendale-EcoforestryInstituteMtGrove.pdf

24. Ecoforestry Management Associates Certificate Number: SW-FM-042
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-OR-PortOrford-EcoforestryManagementAssoc.pdf

25. Ecosystem Management Company, VT, USA SW-FM/COC-090
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/EcosystemManagementFMstakenotif04.pdf

26. Edward A. Tunheim Consulting Forester 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/edwardtunheimfmpubsum04.pdf

27. Edward F. Kocjancic, Inc. 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/kocjancic.pdf

28. Eric Huff and the Big Creek Resource Managers Santa Cruz, California SCS Forest Conservation Program Certificate Number: SCS-RM-00002
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-CA-SanMateo-BigCreekResManagers-EricHuff-SCS2000.pdf

29. Evergreen Ecoforestry, LLC 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/evergreen.pdf

30. Forestry Branch, Fort Lewis Military Installation Department of Defense 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/fort-lewis.pdf

31. Forest, Soil & Water, Inc. 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/forest-soil-water.pdf

32. Fountain Forestry 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/FountainForestryFMpubsum04.pdf

33. Gary Paul Consulting Forester 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/gary-paul.pdf

34. Hale Forestry Company Certification Code: SW-FM/COC-207

35. Hancock Land Company 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/hancock.pdf

36. Harwood Resource Management 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/harwood.pdf

37. Hickman Timber Management Co. 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/hickman.pdf

38. Hoopa Tribal Forestry Certificate Number: SW-FM/COC-068
http://www.hoopa-nsn.gov/documents/Smartwood.pdf

39. Hull Forestlands, LP 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/hull.pdf

40. Individual Tree Selection Management, Inc. 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/individual-tree.pdf

41. Integrated Resource Management, Inc. and Forest Restoration Partnership 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/irm.pdf

42. James L. Able Consulting, Inc.Certificate Number: SW-FM/COC-059
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/
USA-CA-JamesAbleConsulting.pdf

43. Jeffrey Coombs, Consulting Forester 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/coombs.pdf

44. J-Spear Ranch Co. 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/j-spear.pdf

45. Kearse Land and Timber Corporation 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/kearse.pdf

46. Keith Horn, Inc., PA, USA
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/keithhorn.pdf

47. Keweenaw Land Association, Ltd. 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/keweenawfmpubsum04.pdf

48. Mark Andre (CA RPF#2391), Resource Manager 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/markandre.pdf

49. Masconomo Forestry 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/masconomo.pdf

50. McClellan Mountain Ranch Certificate # SW-FM-08
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-CA-Bridgeville-McClellanMtRanchNIPF.pdf

51. McCloud Tree Farm/Hancock Natural Resource Group, Inc. 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/mccloud.pdf

52. Mendocino Redwood Company 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/mendocino.pdf

53. Merck Forest and Farmland Center Certificate Number: SW-FM/COC-088

54. Michael Howell Forestry Consultants 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/michael-howell.pdf

55. Mid-Maine Forestry certification registration number SCS-FM/COC-000049GN
http://www.scscertified.com/PDFS/forest_midmaine.pdf

56. Mike Jani Resource Manager Certificate Number: SCS-RM-00001
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-CA-SanMateo-MikeJaniSCS2000.pdf

57. National Audubon Society - Silver Bluff Plantation and Francis Beidler Forest Certificate Number: SW-FM/COC-168

58. The Nature Conservancy 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/nature-conservancy.pdf

59. New England Forestry Consultants, Inc. 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/nefc.pdf

60. New England Forestry Foundation 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/neforestryfoundationfmpubsum04.pdf

61. New York State Department of Environmental Conservation 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/nydec.pdf

62. North Carolina State University, Department of Forestry 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/ncsu.pdf

63. Olympic Resource Management 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/
documents/olympicresourcefmpubsum04.pdf

64. O'Neill Pine Company 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/oneill.pdf

65. Out of the Woods SCS-FM/COC-00056GN
http://www.scscertified.com/PDFS/forest_outofwood1s.pdf

66. Paul Smith's College Certificate Number: SW-FM/COC-089

67. Perry Gulch Ranch Certification Code: SW-FM/COC-141
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/
USA-CA-Boonville-PerryGulchRanch.pdf

68. Philip E. Nemir certification registration number SCS-FM/COC-00033GN
http://www.scscertified.com/PDFS/forest_nemir.pdf

69. Pioneer Forest 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/pioneerforestfmpubsum04.pdf

70. Potlatch Hybrid Poplar Plantation operations certification registration number SCS-FM/COC-00034P
http://www.scscertified.com/PDFS/forest_potlatchhybrid.pdf

71. Red River Forests Partnership certification registration number SCS-FM-00023
http://www.scscertified.com/PDFS/forest_redriver.pdf

72. Redtree Properties, L.P. 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/redtree.pdf

73. Residents' Committee to Protect the Adirondacks (RCPA) 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/adirondacks.pdf

74. Restoration Forestry, Inc. 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/RestorationFMpubsum04.pdf

75. Robert Whittaker Family Property Certificate Number: SW-FM/COC-051
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/USA-CA-Willits-RobtWhittakerFamily-NIPF.pdf

76. Roseburg Forest Products / Roseburg Resource Company - CA Operations 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/roseburg.pdf

77. Roy O. Martin Lumber Company Limited Partnership 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/martin.pdf

78. Seven Islands Land Management Company of the Pingree Family Ownership certificate number: SCS-FM/COC-00005N
http://www.scscertified.com/PDFS/forest_seven.pdf

79. Shasta Forests SCS-FM/COC-00024N
http://www.scscertified.com/PDFS/forest_shasta.pdf

80. St. John's Abbey, Order of St. Benedict Certification Code: SW-FM/COC-192

81. State of Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry certification registration number SCS-FM/C0C-00011N
http://www.scscertified.com/PDFS/forest_statepenn.pdf

82. State of Maine Department of Conservation Bureau of Parks and Lands (BP&L) certification registration number SCS-FM/COC-00042N
http://www.scscertified.com/PDFS/forest_statemaine.pdf

83. Steve Staub, RPF #1911certificate number: SCS-RM-00003
http://www.scscertified.com/PDFS/forest_stevestaub.pdf

84. Still Waters Farm Certificate Number: SW-FM-041
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/
USA-WA-Shelton-StillWaterFarm-BizerNIPF.pdf

85. Stockbridge-Munsee Community 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/stockbridge.pdf

86. Tennessee Department of Agriculture - Forestry Division 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/tennessee.pdf

87. The Society for the Protection of New Hampshire Forests Certificate Number: SW-FM/COC-062

88. Tree Shepherd Woods 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/tree-shepherd.pdf

89. Two Trees Forestry 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/documents/twotreesfmpubsum04.pdf

90. T & D Thompson, Inc. Certification Code: SW-FM/COC-206

91. Vermont Family Forests 03
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/vermont.pdf

92. Wylatti Timber Management Company, Ltd. 04
http://www.rainforest-alliance.org/programs/forestry/smartwood/pdfs/wylatti.pdf

93. Yale-Myers School Forest CERTIFICATION REGISTRATION NUMBER SCS-FM-00043N
http://www.scscertified.com/PDFS/forest_yalemyers.pdf

94. Whiskey Creek Timber Company Certificate Number: SW-FM/COC-079
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/
USA-OR-Klamath-WhiskeyCreekTimber-Industrial.pdf

95. Zena Timber Certificate Number: SW-FM/COC-061
http://www.stanford.edu/class/anthsci167/CountryManuals/UnitedStatesPNW/USCertificationAssessments/
USA-OR-Rickreall-ZenaTimber-Industrial.pdf

APPENDIX F

Concepts Associated with FSC Forest Certification drawn from the Literature Review that were Used in the Forest Certification Case Study

FSC PRINCIPLE	CONCEPTS
Principle #1 Compliance with laws and FSC Principles	• Respect all national and local laws and administrative requirements. • Comply with applicable and legally prescribed fees, royalties, taxes and other charges • Observe the provisions of all binding international agreements such as CITES, ILO among others • Follow the FSC Principles and Criteria • Avoid illegal harvesting, settlement and other unauthorized activities. • Demonstrate a long-term commitment to adhere to the FSC.
Principle #2 Tenure and use rights and responsibilities	• Demonstrate long-term forest use rights to the land (e.g. land title, customary rights, or lease agreements) • Control over tenure or use rights • Establish mechanisms to resolve disputes over tenure claims and use rights
Principle #3 Indigenous peoples' rights	• Promote that indigenous peoples should control forest management on their lands and territories • Encourage that resources or tenure rights of indigenous peoples should not threaten or diminish • Enhance the conservation of sites of special cultural, ecological, economic or religious significance to indigenous peoples compensate indigenous peoples for the application of their traditional knowledge regarding the use of forest species or management systems in forest operations
Principle #4 Community relations and worker's rights	• Give opportunities for employment, training, and other services to local communities • Comply all applicable laws and/or regulations covering health and safety of employees and their families. • Guarantee the workers' rights to organize and voluntarily negotiate with their employers • Incorporate the results of evaluations of social impact • Employ appropriate mechanisms for resolving grievances and for providing fair compensation in the case of loss or damage affecting the legal or customary rights, property, resources, or livelihoods of local peoples
Principle #5 Benefits from the forest	• Attempt toward economic viability, while taking into account environmental, social, and operational costs of production • Encourage the optimal use and local processing of the forest's products diversity • Minimize waste associated with harvesting and on-site processing operations • Strength and diversify local economy • Recognize, maintain, and, where appropriate, enhance the value of forest services • Respect rate of harvest tobe sustained.

FSC PRINCIPLE	CONCEPTS
Principle #6: Environmental impact	• Assess environmental impacts, conserve rare, threatened and endangered species and their habitats • Maintain, enhance or restore forest regeneration and succession, genetic, species, and ecosystem diversity, and natural cycles that affect the productivity of the forest ecosystem. • Implement guidelines to control erosion; minimize forest damage during harvesting, road construction, among others • Promote the development and adoption of environmentally friendly non-chemical methods of pest management • Dispose wastes in an environmentally appropriate manner at off-site locations. • Control the use biological control agents and monitor the use of exotic species • Avoid forest conversion to plantations except in a limited portion of the forest management unit, it does not take place on high conservation value forest, and will enable secure conservation and benefits in the forest management unit.
Principle #7: Management plan	• Provide objectives, description of forest resources, environmental limitations, description of silvicultural treatment, rationale for rate of annual harvest, procedure for monitoring of forest growth and dynamics, environmental safeguards based on environmental assessments, among others • Be periodically revised to findings of monitoring or new scientific and technical information • Forest company shall: ensure that staff receive adequate training and supervision to ensure proper implementation of the management plan.
Principle #8: Monitoring and assessment	• Determine the frequency and intensity of monitoring should, and it should be determined by the scale and intensity of forest management procedure • Include the research and data collection needed to monitor such as yield of products harvested, growth rates, regeneration, composition and changes in flora and fauna, environmental and social impacts, among others. • Supply evidence to trace forest product from in the chain of custody • Incorporate the feedback provided by monitoring
Principle #9: Maintenance of high conservation value forests	• Determine the presence of characteristics related with High Conservation Value Forests • Identify in a participatory process the conservation attributes and options to maintain them • Incorporate and accomplish actions to ensure the maintenance and/or enhancement of High Conservation Value characteristics • Assess the efficacy of actions used to improve conservation attributes.

CODING FORM

FSC REPORT ID ________________________

Principle #1: Compliance with laws and FSC Principles

Respect all national and local laws and administrative requirements. ________
Comply with applicable and legally prescribed fees, royalties, taxes and other charges ________
Observe the provisions of all binding international agreements such as CITES, ILO among others ________
Follow the FSC Principles and Criteria ________
Avoid illegal harvesting, settlement and other unauthorized activities ________
Demonstrate a long-term commitment to adhere to the FSC ________

Principle #2: Tenure and use rights and responsibilities

Demonstrate long-term forest use rights to the land (e.g. land title, customary rights, or lease agreements) ________
Control over tenure or use rights ________
Establish mechanisms to resolve disputes over tenure claims and use rights ________

Principle #3: Indigenous peoples' rights

Promote that indigenous peoples should control forest management on their lands and territories ________
Encourage that resources or tenure rights of indigenous peoples should not threaten or diminish ________
Enhance the conservation of sites of special cultural, ecological, economic or religious significance to indigenous peoples compensate indigenous peoples for the application of their ________

Principle #4: Community relations and worker's rights

Give opportunities for employment, training, and other services to local communities ________
Comply all applicable laws and/or regulations covering health and safety of employees and ________
Guarantee the workers' rights to organize and voluntarily negotiate with their employers ________
Incorporate the results of evaluations of social impact ________
Employ appropriate mechanisms for resolving grievances and for providing fair compensation ________

Principle #5: Benefits from the forest

Attempt toward economic viability, while taking into account environmental, social, and operational costs of production ________
Encourage the optimal use and local processing of the forest's products diversity ________
Minimize waste associated with harvesting and on-site processing operations ________
Strength and diversify local economy ________
Recognize, maintain, and, where appropriate, enhance the value of forest services ________
Respect rate of harvest to be sustained ________

Principle #6: Environmental impact

Assess environmental impacts, conserve rare, threatened and endangered species and their habitats ________
Maintain, enhance or restore forest regeneration and succession, genetic, species, and ________
Implement guidelines to control erosion; minimize forest damage during harvesting, road ________
Promote the development and adoption of environmentally friendly non-chemical methods of pest management ________
Dispose wastes in an environmentally appropriate manner at off-site locations ________
Control the use biological control agents and monitor the use of exotic species ________
Avoid forest conversion to plantations except in a limited portion of the forest management unit, it does not take place on high conservation value forest, and will enable secure conservation and benefits in the forest management unit ________

Principle #7: Management plan

Provide objectives, description of forest resources, environmental limitations, description of silvicultural treatment, rationale for rate of annual harvest, procedure for monitoring of forest growth and dynamics, environmental safeguards based on environmental assessments, among others ____________________

Be periodically revised to findings of monitoring or new scientific and technical information ____________________

Forest company shall ensure that staff receive adequate training and supervision to ensure proper implementation of the management plan ____________________

Principle #8: Monitoring and assessment

Determine the frequency and intensity of monitoring should, and the scale and intensity of forest management ____________________

Include the research and data collection needed to monitor such as yield of products harvested, growth rates, regeneration, composition and changes in flora and fauna, environmental and social impacts ____________________

Supply evidence to trace forest product from in the chain of custody ____________________

Incorporate the feedback provided by monitoring ____________________

Principle #9: Maintenance of high conservation value forests

Determine the presence of characteristics related with High Conservation Value Forests ____________________

Identify in a participatory process the conservation attributes and options to maintain them ____________________

Incorporate and accomplish actions to ensure the maintenance and/or enhancement of High Conservation Value characteristics ____________________

Assess the efficacy of actions used to improve conservation attributes ____________________